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ABSTRACT

Developed for use by students or professionals in education and information or library science seeking national or international resources on computer-assisted instruction, this resource guide is divided into five major sections. The first section includes a glossary of acronyms as well as background information on microcomputers and computer-based education and a sample entry of the format for items in the guide. The second section includes a discussion of the benefits of microcomputer use, an outline of an inservice education program designed to help teachers become computer literate, and an extensive annotated list of readings dealing with the need for computer use in educational settings and associated issues. The selection and evaluation of hardware and software are addressed respectively, in the third and fourth sections, which include brief explanations of microcomputer and software components, basic evaluation methods for hardware and software selection, and annotated lists of readings on these two topics with an emphasis on the international setting. The fifth section provides descriptions of the school environment in industrial, newly industrial, and developing countries, together with annotated resource lists for each of the countries discussed. The examples used include the United States as an industrialized country with additional information on England and Canada; Australia and Japan as newly industrialized countries; and India as a developing country with additional materials on other developing countries. Both an annotated list of eight references and a 34-item bibliography are also provided. (RP)

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International resources for the evaluation of micro-computer hardware and software used in schools

by

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Glossary

AECT- Association for Educational Communications & Technology

AEDS- Association for Educational Data Systems

CAD- Computer-assisted design

CAI- Computer-assisted instruction

CAL- Computer-assisted learning

CBE- Computer-based education

CBI- Computer-based instruction

CLASS- Computer-based learning for automated school systems

CMI- Computer-managed instruction

COSTI- National System for Scientific & Technological Information

CPU- Central processing unit

DEC- Digital Equipment Corporation

DOS- Disk operating system

ECTJ- Educational Communication & Technological Journal

EDRS- Eric Document Reproduction Service

EPIE- Educational Products Information Exchange Institute

HSRC- Human Services Research Council

IBM- International Business Machines

ICCE- International Council for Computers in Education

IFIP- International Federation for Information Processing

IFLA- International Federation of Library Associations

IRCIHE- International Referral Center for Information Handling Equipment

LSI- Large scale integration

MECC- Minnesota Educational Computing Consortium

NCERT- National Council for Educational Research and Training

PDP- Programmable Data Processor

PI- Programmable instruction

RAM- Random Access Memory

ROM- Ready Only Memory

SDC- Systems Development Corporation

SLIC- School Libraries in Canada

TASAWA- Tasmania, South Australia, & West Australia computer consortium

TERC- Technical Education Research Center

VALA- Victorian Association for Library Automation

WCCE- World Conference on Computers in Education

I. Introduction.

A. Micro/Minicomputer background information.

Microcomputers are the lowest priced computers now on the market and developed because of great advances in the microprocessor field in the last 15 years. These developments allowed microprocessors to be produced quickly and cheaply so that micro and minicomputers would also also be produced at less and less cost. The microcomputer is a digital computer which consists of a number of LSI chips (Large scale integration) Large scale integration is a means of producing the tiny microcircuit chips which replace the printed circuit boards that would be used. One of these chips, the size of a small nail head, contains more circuitry than a printed circuit board 28 cm by 50 cm. A typical microcomputer consists of a number of chips contained on a board much smaller than a card catalog card. One of the chips is the microprocessor which is the device performing logical operations such as adding, subtracting, moving or shifting data within the central processor. Another chip has the core or main memory which the central processor needs to store the data and program instructions to operate the system. Another chip aside from these contains input/output circuitry allowing other devices to be plugged into the microprocessor to make it a microcomputer. (some of these devices: keyboards, disk drives, printers, etc.) Micro refers to physical size rather than limits to what it can do. There are three types of microcomputers. They are arranged by the number of bits used to form the length of their data.

1. Four bit processors - mostly used in electronic calculators or similar numeric processing applications.
2. Eight bit processors - for applications requiring a more flexible computer to handle text and numeric processing. These are the most widely used computers. (examples: Commodore, Apple II's, Tandy TRS-80's, etc)
3. Sixteen bit processors - the more powerful minis (examples: DEC's, PDP II's, etc) used in many information applications.

The advent of the microprocessor will be responsible for many changes in our lifestyles within the near future. It is now monitoring many functions in the automobile, controlling microwave ovens, performing several functions in wristwatches. In the business world, microcomputers are being used with their application in word processors. They often have multiple uses such as word processing, accession of external databases (Lockheed, SDC), text editing, compter terminal, and communications link to other word processors. The term minicomputer was first used in 1968 when IBM developed a computer that was named 'Mini' but they did not produce a true minicomputer until 1973 when the IBM System 7 and then Series I computers were produced. The mini computer uses a central processing unit, a basic amount of main memory and can be purchased for under $25,000.

The largest breakthrough for information workers was with the development of word processors. These began as a means to mechanize

typewriter functions of offices but developed rapidly and capabilities were extended to allow them to become intelligent terminals capable of services such as electronic mail, COM's input terminal access to in-house and external computers, telex access and communication links to compatible equipment. Digital Equipment Corporation or DEC introduced Programmable Data Processors or PDP's in the late 1950's for word processing. The advent of the microcomputer was not until 1975. Manufacturers began producing software packages which included basic data processing capabilities, information storage and retrieval, and electronic message switching. Within their own business, the manufacturers developed their own word processing systems using their small computers as central processing units for shared logic systems. Computers were thus brought into the everyday world. Costs are dropping as microprocessors become more powerful and less expensive to produce. The storage of information is becoming cheaper as newer devices for storage come into existance. Most firms that must be budget conscious agree that there is cost justification. The microcomputers that are now being used in homes and schools (PETS, Apples, Tandys, etc) all have word processing software packages available so they can not only edit but store and retrieve information as well. The largest manufacturer of micro and minicomputers is the Digital Equipment Corporation.

B. Computer Based Education background information

The microcomputer has had a larger impact on Education than any other type of machine. Since the computer/electronics industry has grown so tremendously and has entered so many facets of business, job skill requirements make education's responsibility to computer literacy a must. Many companies produce microcomputers for a wide range of applications but only a few are used consistantly in the educational market. These companies are: Tandy Corporation (TRS-80), Apple Computers (Apple II and II+), and Commodore Business machines (PET). IBM, a corporation traditionally selling larger machines has produced a personal computer that is becoming very popular. Microcomputers are in use in computer literacy programs, high school computer science curricula, programming courses, programs for gifted and talented students, and many others.

Educational uses of computers are basically of three kinds:

1. Research Uses
   a) About computers - In higher education, computer science departments research methods of design to develop the use of computers.
   b) With computers - Using computers as tools for research in information gathering, storage, and analysis.
2. Administrative Uses
   To help with management problems (payroll processing, inventories, budget projection, etc.)
3. Instructional Uses
   a) About computers - activites related to helping students become familiar with uses and effects of computers in daily life and on the job. Usually this is called computing or computer literacy. This would include the running of computer software programs to help students gain confidence in using computers or teaching computer programming (usually with BASIC)

b) With computers - using the computer as a tool in instruction. This process is called Computer Based Education or CBE. Computer Based Education is divided into two parts:

1) Computer-Managed Instruction or CMI - using the computer to control or manage instruction. The instructor has many clerical and administrative duties including planning, sequencing various tasks or assignments, organizing materials, and grading assignments. Many of these can be handled by a computer.

2) Computer-Assisted Instruction or CAI - in Europe, CAI is referred to as Computer-Assisted Learning or CAL; another term meaning about the same as the other two is Computer-Based Instruction or CBI. All of these refer to using computers as a means of instruction. There are categories of instruction:

Drill and Practice - this method will help to promote knowledge or skill by repetition of the information. (example: memorizing of spelling or vocabulary) Teachers do not have time to help each student with drills which would promote learning the material. The entire task in this instance can be clearly specified and so can be completed on computer. There are two kinds of drill and practice programs:

1. Programs that show lists of materials and then ask for a response. (examples: matching musical sound to appropriate notation or give a list of vocabulary words and ask for a response in another language)
2. Programs that generate materials according to a pattern. (problems in arithmetic - computer selects two numbers and asks for a certain operation)

Dialogue - tries to produce a type of interaction between student and teacher which results in the attainment of information. There are two kinds:

1. Tutorials - provide a method for entering text frames, right and wrong answer options, feedback options, and methods to select other material based on the response.
2. Inquiries - the computer has information that the student must try to obtain through a student-initiated dialogue. The student is given an information environment and set of rules for getting the information. (example: chemistry - student is required to identify through lab procedure an unknown chemical element)

Simulation - controlling the representation of real world phenomena. If real experiences are not available, simulations may be used. There are 3 types (may have other labels):

1. Task Performance - generally goal oriented and help students develop skill in completing a task.

(examples: flight and driving simulations)
2. Systems modeling - to help students to gain information, achieve insight, and understanding about a system. (examples: world populations, solar system, human anatomy, transportation systems)
3. Experience/Encounter - used to expose students to experiences otherwise unavailable. (example: the experience of travelling to a foreign country can be simulated by working through the process of passport attainment, selection of items to pack, negotiating customs inspections, reading menus, etc.)

Games - a goal-oriented activity which can be successfully completed by the application of rules with skill. The playing of the game is an exercise in problem solving. These are a lot like simulations.

Testing - computers could be used in testing and evaluation. The system of computer-assisted testing has 5 parts:
1. Test construction - questions are stored in text files, the order of the items is scrambled by the computer so that 2 or 3 version of the test can be produced reducing the ease of cheating.
2. Test delivery - students can take the test at the terminal. The order of questions can be changed with each student and computer is programmed to know which question is asked and remember the student's response, typing and grading tests and handling papers is eliminated, students receive grades as soon as the test is over.
3. Grading and analysis - if there are paper delivered tests, mark-sense answer sheets can be made and students then write answers to multiple choice questions. An optical scanner can record student responses and grade the test. With specific software, a profile of the test can be constructed including how scores are distributed, identifying of questions too hard or too easy, grades can be printed out or reported to an electronic grade book.
4. Item Analysis - this involves a reevaluation of test questions. For example, the more knowledgeable students should be able to answer questions more correctly most of the time and so an item which is not answered correctly by the more knowledgable students is not a good question and should be weeded.
5. Item Banking - requires sophisticated software and an item bank may take years to develop. Items are place by category according to a specific field that they belong to (Math, English, etc.) each field may be further subdivided as many times as needed to create pools of items which apply to different instructional objectives. There should be many items testing the same idea. This allows creation of many forms of a test.

Problem solving - sometimes it is impossible for stu-

dents to write down step by step representations of a huge problem because they would lose track of the problem as a whole. On the computer, a problem can be analyzed by using a computer program to produce the correct result, and the student is relieved of the burden of computation. There are variations of this method in areas other than mathematics. (for example: business schools use programs such as Interactive Financial Planning systems to help students become skilled in solving problems associated with financial planning and use of spread sheets)

Discovery Learning - a method of placing students in structured environments, giving them tools for exploring, analyzing, and successfully learning new ideas and principles. An example of this type of learning is the work by Seymour Papert and associates. Many children have problems learning basic ideas and operations in mathematics. One product of his research has been LOGO which is a sort of computer programming language allowing students to communicate with the computer in simple terms. (it is a graphics package language) Many of the principles of math are a part of the language itself and the children apply these basic principles in an enjoyable and motivating way.

C. Sample entry of format for items in the guide

ERIC Document

ED 272 149	
ERIC Doc. #	
Author	United Nations Educational, Scientific, and Cultural Organization, Bangkok (Thailand). Regional Office for Education in Asia and the Pacific.
Title	Computers in Education. Final Report of the Asian Seminar on Educational Technology (3rd, Tokyo, Japan, September 26-October 2, 1984).--Japan Council of Educational Technology Centers, Tokyo; Japanese National Commission for UNESCO, Tokyo, 1984.
Place pub. & Publisher	
Date Published	
Paging	102 p.
Price	MF01/PC05 plus postage
ISBN # (if have)	ISBN #
Abstract (content) if have	Where to obtain the document will be given as well

Reading

Author	Sadowski, Barbara R. "A model for preparing teachers
Title (article)	to teach with the Microcomputer."
Title (journal)	Arithmetic Teacher
Vol & No.	30 (6) February 1983: 24-25, 62
Month & year	
Page nos.	
Abstract (content)	Provides overview of approaches for designing teacher in-service and preservice programs.

Book

Author	Leggett, Stanton, ed. Microcomputers go to school.
Title	New York: Teach-'Em, Inc., 1984.
Place published	
Publisher	
Date pub.	
Abstract (content) if have	

D. Purpose of the Guide

1. User Group

This resource guide will be for students or professionals in the fields of Education, Information, or Library Science who would be concerned with computer-based learning and the available resources involved with it on either a national or international level. The explanatory portions have been kept as simple as possible with acquisition instructions clear and complete.

2. Coverage/Scope

The type of computer system used in Education is fairly recent. (10 years or so) The use, to any extent, of the equipment and software needed for computer-based/assisted learning started about then, but adequate applications for the hardware is still being pursued, and in developing countries, there still is very sparse usage on the elementary and secondary level, if any.

Most of the international information is obtained through world conferences and projects sponsored by UNESCO. Some international organizations are trying to make strides in the area of micro-computer information, services, and products for school use as well as library use.

II. The need for microcomputer use common to all educational settings.

A. Benefits of microcomputer use

1. Microcomputers are used in almost every area of modern life as well as a means of making a living in many areas of business. Some kind of training in the schools must be arranged in order to help accomodate the need for trained personnel. Learning to use a computer this way is using it as a tool, and there are plentiful computer software packages available on the market to cover this use. (word processing, data base management, spreadsheets, telecommunications, graphics, etc.)

2. The continuing cost reduction in manufacturing makes computer purchase much more economically feasible. Every 5 years there has been a decrease in equipment cost by half.

3. The space required for a microcomputer system is much less than older systems required and could be fitted into a classroom situation.

4. Computers are constantly becoming easier to use. For example, complex tool programs can often be used without reading printed manuals as demonstrated by Scholastic's Bank Street Writer. The computer program is interacitve and has good instructional design in that it presents a concept; introduces the keystroke sequence necessary to accomplish the task a and then gives a practice problem which is monitored by the computer. (you can't just hit Return or Escape to advance unless the task has been accomplished) The tutorial also will not allow substitution of another method that avoids using the skill being taught. It is also short and to the point. It will soon be common to operate computers by speech as well.

5. The CAI packages interact with a student on a one to one basis which is not something that is possible in a regular classroom situation very often. A student would feel that he/she is the object of attention and respond accordgingly.

6. The student can be directly involved in judging his or her own success measured against a set of carefully constructed goals. For example, software packages for Science laboratory experiments actively involve the student in discovering the principle of a phenomena. Laboratory experiments can be meaningless exercises in measuring to many students with the object of the experiment excaping them altogether. With a package such as the one on the market concerning the principle of the pendulum, the investigation can be repeated in order to test an idea or check measurements, there is a visual representation of measurements in the form of a curve on the screen, and he or she can go at his/her own pace. The phenomena is the focus of concentration, not the counting and timing. Advanced students can design their own experiments.

7. A student can profit from being allowed to work at his/her own pace; quickly throught the familiar and more slowly with new material. A general pace for an entire class does not have to be imposed on the learner.

8. The student becomes more involved with the material being learned since he must respond with the correct answer before going on, and as he really learns the material, becomes more and more motivated.

9. The computer provides stimulation in the form of graphics, animation, color, and sound which helps to keep the attention level high.

10. While using the computer for CAI rather than a tool, users are still gaining computing skills and are learning to teach themselves.

11. Computers can relieve the teacher of repetitive tasks and so allow them to pay closer attention to each student's work.

12. Testing and scoring on a computer makes it easier to monitor the progress of the student.

B. The basis for obtaining desired benefits of Computer-Assisted Instruction.

Before microcomputers are introduced into a classroom, certain things must be accomplished in order to have a successful computer situation. It is not enough to have a brief training session or one time workshop. The teacher must be aware of what the microcomputer's capabilities and functions include. There is a need for in-depth training. The programs used in each classroom must accomplish specific goals through careful planning or careful software selection.

Given here is a sample of an Inservice program for teachers to help them become computer literate.[1] This does not include having to program.

Session 1: Hardware Basics

Objective: List name and function of the main components of a microcomputer.
Load, catalog and run computer software.
Prepare the printer for operation

Instructional sequence: Identify each major compenent of the microcomputer and explain its function.
If possible, open up and display the inside of the computer. Explain the basic parts.
Step through the process of loading a disk, requesting a catalog, and calling up a program.
Step throught the sequence of preparing the printer for operation.

Activities: Allow participants to insert and remove the cards.
Allow participants to load, catalog, and run several sample programs. (self-directed program teaching the keyboard is good)

Materials: Printed materials detailing parts and their function in the computer; instructions for loading a disk, running a program and operating the printer.
Sample programs.

Session 2: Software Basics

Objective: Categorize the different types of educational software.
Make back-up copies of unprotected disks.
List the major factors in software evaluation.

Instructional Sequence: Review major concepts in previous session.
Explain the difference between major types of educational software (Instructional, Research(utility), and Administrative) with brief demonstration of each if possible.
Explain the difference between protected, unprotected, and public domain software and to erase disks so they can be reused.
Give out one or more types of software evaluation forms. Explain major factors to consider.

Activities: Allow participants to copy public domain software. Explain

1. Callison, William L. Using computers in the classroom. Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1985. pp 111-115.

how to copy a backup copy of a protected program where this is possible.
As a group, evaluate a piece of educational software.

Materials: Printed material detailing disk copying routine.
Printed software evaluation forms
Protected and public domain disks
Disk with copy program such as DOS 3.3 System Master for Apple

Session 3: Software-Teacher Utilities

Objective: Define what a teacher utility is.
Produce student worksheet using one of the teacher utilities.

Instructional Sequence: Define teacher utility. Give examples.
Demonstrate variety of teacher utilities.

Activities: Allow participants to use and produce their own materials for classroom use with teacher utility software such as that available from Minnesota Educational Computing Consortium.

Material: Printed material detailing use of the utilities.
Variety of utility programs

Session 4: Teacher Management Software

Objective: Define what a management program does.
Use several management programs.

Instructional Sequence: Define what management software is and show how it can assist teachers. Give examples of useful teacher management programs such as grade recording, grade analysis and reporting, data base management, and if time, electronic spreadsheet prog.

Activities: Allow teachers to practice running programs; set up and load files, practice calling up files, revise information in files, insert new material into files, and print out all and part of a file.

Materials: Printed materials summarizing how to use each teacher management program you use.
Printed material showing previous use of management programs as they were printed out and necessary program disks.

Session 5: Instructional Software and software evaluation.

Objective: List the types of instructional programs available.
Evaluate instructional programs suitable for the teacher's grade level/subject area

Instructional Sequence: Define the goal of instructional programs and show how different program types seek to achieve their goals(dril and practice, tutorials, games, and simulations.

Demonstrate each type of instructional program, preferable in different subjects/grade levels.

Activities: Allow participants to compare variety of instructional programs of differing types at differnet grade levels and in variety of subjects.
Use software evaluation list to evaluate several programs.

Materials: Printed materials summarizing types of instructional software.
Software evaluation forms.
Variety of instructional programs to evaluate.

The above program is a basic one that will help the teacher to become more able to cope with computer use in the classroom. Other programs for those teacher that want to go on from here could be devised to teach them programming and how to design their own curriculum software.

C. List of resources dealing with the need for computer use in educational settings and associated issues. (in addition to the bibliography)

Readings

Beck, John. "Paradigm for computer literacy training for teachers." Computing Teacher 9 (2) October 1981: 27-28.
Explains the need for teachers to have computer instruction. Outline for a workshop.

Bell, Trudy E. "My computer, my teacher." Personal Computing 7 (6) June, 1983: 120-127.
Synthesis of several studies of the uses of computers in education and what this means for the future.

Bell, Norman T. "A computer awareness program for all teachers and all students." Technological Horizons in Education 11 (1) September 1983: 138-141.
Ten lesson program in computer awareness.

Chaffee, Mark A. "Use of microcomputers in the Elementary and Junior High schools." Classroom Computer News 2 (4) March-April, 1982: 17, 76.
Discusses concerns and recommendations in the purchase and use of micros in schools and suggests that a computer committee be established to decide on the immediate and future goals.

Deringer, Dorothy K. "New directions for Education in the Information Society?" Technological horizons in Education 11(1) September 1983: 110-11.
What basics are now mandated by the new information society.

Educational Leadership 41 (1) September 1983.
Entire issue discusses the future of education and the potential role of computers in it. (positive and negative aspects)

Eisele, James E. "Computers in the schools : now that we have them...?" Educational Technology 21 (10) October 1981: 24-7.
Four unique applications of the microcomputer to the classroom.

Favaro, Peter. "My 5 year old knows BASIC." Creative Computing 9 (4) April 1983: 158-66.
How a child's cognitive and behavioral development can be affected by the use of a computer.

Filliman, Paula K. " Guidelines for introducing microcomputers in the schools." Arithmetic Teacher 30 (6) February 1983: 16-17, 56.
Guidelines for planning and using micros in a school district.

Frenzel, Louis. "Computer literacy--who needs it?" Interface Age 6 (3) March 1981: 38-40.
Definition of computer literacy. Discusses pros and cons of bringing computer literacy to our society.

Gallini, Joan K. "What computer assisted instruction can offer toward the encouragement of creative thinking." Educational Technology 23(4) April 1983: 7-11.
Use of computers to foster creativity in schools.

Melmed, Arthur S. "Productivity and technology in Education." Educational Leadership 40 (5) February 1983: 4-6.
The need to improve educational productivity to avoid the decline in student achievement. Educational Computing is suggested as a solution.

Merton, Andrew. "Computers in the classroom." Technology Illustrated 3 (9) September 1983: 38-46.
In depth discussion of the issues surronding the use of computers in the classroom.

Murphy, Edward. "Developing computer literacy in K-12 Education." Computing Teacher 9 (3) November 1981: 43-48.
Goals and achievements of a group of NY teachers, supervisors, etc. working with computer education.

Olds, Henry. "Teaching the teachers." Classroom Computing News 3 (6) May-June 1983: 52-55.
In-service syllabus for teaching teachers about computers.

Watts, Norman. "A dozen uses for computers in education" Educational Technology 20 (4) April 1981: 18-22.
Twelve major applications of micros in educational settings.

Platt, Andy and Byron, Ruth. "Designing the computer-literate school." Classroom Computer Learning 4 (2) September 1983: 56-60.
One school's experiences planning and implementing microcomputer programs.

Wright, Edward B. and Forcier, Richard C. "Teacher-education curriculum for the 80's" Educational Computer Jan-Feb 1983: 56-8.
Experimental program to put computer education into Liberal Arts and teacher education. Courses available in the area of computer based instruction for education majors.

The readings listed can be obtained through Interlibrary Loan at your nearest public library. Usually a xeroxed copy of the article desired will be sent and there may be a charge per page which is usually mentioned by the person helping you with your request. If you happen to be near a university, the library there may have some of the journals by subscription in which case you could read the article there or xerox it yourself. It is sometimes possible to write to the magazine and ask if back copies are available. (most of the time they are) A list of journals dealing with microcomputers in education (whether national or international) along with addresses will be given at the end of this section to allow purchase of subscription or back copy if desired.

Books

Annual bibliography of computer oriented books. 5th
Colorado Springs, Co: University of Co., Computing Newsletter, 1982.
Over 1,000 titles in 63 categories with complete bibliographic and ordering data.

Computing Newsletter
Box 7345
Colorado Springs, Co 80933

Barrette, Pierre, ed. Microcomputers in K-12 education.
Rockville, Md: Computer Science Press, Inc., 1982
Effects of new technologies in K-12 education. Computers in Special Education, Administration, Business Education, Mathematics, Reading, and Language Arts.

Computer Science Press
11 Taft Court
Rockville, Md 20850

Beaumont, Jane and Krueger, Donald R. Microcomputers for libraries: How useful are they?
Ottawa: Canadian Library Association, 1983.
Ten articles concerning the use of microcomputers in libraries. Management functions, professional development, communications, software, library applications, etc. Bibliography.

Canadian Library Association
151 Sparks St.
Ottawa, Ontario
ON K1P 5E3, Canada

Clay, Katherine. Microcomputers in Education: a handbook of resources.
Phoenix, Az: Oryx press, 1982
State of the art resources guide. Topics: future trends, computer literacy, philosophy, classroom applications, management applications, selection/evaluation criteria, teacher/administrator education, research studies, home computers, and references/resources.

Oryx press
2214 North Central at Encanto
Phoenix, Arizona 85004

Coburn, Peter et al. practical guide to computers in education. Reading, Ma; Addison-Wesley Pub. Co., 1982.
Historical context and overview of computers in classrooms and media centers.

Addison-Wesley publishing Co.
Jacob Way
Reading, Ma 01867

Corbitt, Mary Kay. Guide to resources in instructional computing. Reston, Va: The National Council of Teachers of Mathematics (NCTM), 1984.
Bibliography of articles about computers in education.

National Council of Teachers of Mathematics (NCTM)
1906 Association Dr.
Reston, Va 22091

Learning with Microcomputers. Washington, DC: Association for Educational Communications and Technology (AECT), 1983.
Collection of articles from Instructional Innovator on how computers are used to solve learning and teaching problems.

Association for Educational Communications and Technology
1126 16th St., NW
Washington, DC 20036

Robbat, Richard J. Computers and individualized learning. Eugene, Oregon: ERIC Clearinghouse on Educational Management and the International Council for computers in Education, University of Oregon, Eugene, 1986.

ICCE
University of Oregon
1787 Agate St.
Eugene, Oregon 97403

Waite, Mitch and pardee, Michael. Microcomputer primer 2d. Indianapolis, In: Howard W. Sams and Co., Inc., 1981.
Introduction to microcomputers and basic computer concepts. Discusses the electronics behind logical operations, programming and operating systems, etc.

Howard W. Sams and Co., Inc.
4300 West 62nd St.
Indianapolis, In 46268

Tashner, John, ed. Improving instruction with microcomputers: readings and resources for elementary and secondary schools. Phoenix, Az: Oryx press, 1984.
Overview of microcomputers in schools: computer literacy, computer languages, integrating microcomputers into school curricula, hardware and software, annotated bibliography, list of resources, etc

Oryx press
2214 North Central at Encanto
Phoenix, Az 85004

ERIC Documents

ED 176 804 Rushby, N.J.
Computer-based learning in Europe: a bibliography. London University (Eng): Imperial College Computer Centre, 1978.
172 references to papers on computer assisted learning, CAI, in European countries including: Soviet Union, Germany, Holland, Sweden, Yugoslavia, Austria, and Italy. Concerned with training of teachers, rural education, model construction, program evaluation, computer managed instruction, etc

ED 227 823 Olivero, James L.
Your basic guide to micro-computers: a primer. Redwood City, Ca: San Mateo Office of Education, 1982.
For teachers and administrators with no prior knowledge of microcomputer applications in education, answers questions asked on use of microcomputersfocusing on their use for computer assisted instruction, drill and practice, and instructional games. Background information on microcomputers, educational issues, etc.

ED 234 741 Edwards, Judith B.
Computer applications in instruction: a teacher's guide to selection and use.
Washington, D.C.: National Institute of Education (DHEW) & National Science Foundation, 1978.
practical advice on determining the appropriate application of computer technology and selection of specific, subject-related computer based

instruction units.

ED 243 443 Van Dusseldorp, Ralph.
Microcomputer laboratory manual.
Anchorage, Alaska: Alaska University, School of Education, 1984.
Guide to develop basic computer competencies for students in teacher preparation programs or as in-service training for teachers. Basic information, worksheets, computer programs, and hands-on learning activities for 16 proficiencies related to computer literacy.'

ED 243 452 Higgins, James E.; Linville, William J.
Using microcomputers in schools: some initial considerations.
Terre Haute, Indianna: State University, School of Education, 1984.
Instructional and administrative uses of microcomputers are considered. Current condition in schools, hardware, software, drill and practice, word processing, simulation, and tutorials, skill in microcomputing needed by teachers, etc. List of software companies.

ED 249 918 MicroSIFT courseware evaluations and special set Junior High Science software.
Portland, Oregon: Northwest Regional Educational Laboratory, 1984.
170 micro software evaluations by MicroSIFT Clearinghouse at the NoW Regional Educational Lab.
for previous documents in this series:
ED 226 765 ED 239 606
ED 234 722 ED 245 666

ED 251 061 Everest, Kenneth.
AMTEC '84...Kaleidescope of media, papers, and workshops. (London, Ontario June 17-20, 1984)
16 conference papers and presentations and brief descriptions of 35 workshops and demonstrations with information on computers in the classroom, micros in Elementary Schools, television teaching, educational technology and the brain, visual literacy, etc.

ED 258 538 The introduction of new information technologies in education: policy trends and developments in member countries.
Paris (Fr): Organisation for economic co-operation and development at Centre for Educational Research and innovation, 1984.
International Conference on Education and new information technologies.
Major policy developments relating to elementary

and secondary education and new technologies with strategies to implement policies. Also primary and secondary education trends with overview of events in recent past, present developments and future trends in these countries: Australia, Austria, Canada, Denmark, France, Germany, Iceland, Ireland, Italy, Luxembourg, Netherlands, New Zealand, Sweden, UK, US, Belgium, Switzerland, Finland, Greece, Japan, Norway, Portugal, Spain, and Turkey.

ED 258 561 International Conference proceedings of the Association for the development of computer-based instructional systems (26th, Philadelphia, Penn., March 25-28, 1985)
Philadelphia, Penn: Assoc. for the development of computer-based instructional systems, 1985.
53 papers on the use of computer-based learning. Computer-based training; Elementary, Secondary, and Jr. College, handicapped uses, Health Ed., Home Ec., etc.

ED 258 902 Hepburn, Mary A.
New information technology in Social Science education: viewpoints from Europe and the US. Annual Conference of Social Science Education Consortium (20th, Athens, Ga, June 8-11, 1983)
Boulder, Colo:Social Science Education Consortium, Inc., 1985.
14 conference papers on the effects of electronic information technology on social studies education with most of the information on microcomputers and then satellite telecommunication..

ED 261 351 Singer, Harry; Phelph, Patricia.
The history of computers and their use in education. Annual meeting of the National Reading Conference (32nd, Clearwater, Florida, Dec 4-6, 1982)
Clearwater, Florida: 1982
For educators of all levels; development of the computer from its beginning to present and discusses how computers can best be used in education.

ED 262 753 Sherwood, Robert D.
Models of computer use in school settings. Tech. Report Series # 84.2.2
Nashville, Tenn.: George Peabody College for Teachers
Techniques that might be used with computers to

help students learn. Five types of computer use in educational settings. Methods of each discussed and specific software packages that could be used for each use.

ED 263 086 Warren, Thomas F.
Partners in curricular reform: computers and creativity. World Assembly of the International Council on Education for teaching (32nd, Vancouver, British Columbia, Canada, July 22-26, 1985)
Survey of teachers in a group of schools has indicated that substantial creative behavior is demonstrated by children who use the computers. Creativity has shown up most clearly when pupils program and when they write using the word processing capabilities of the computer.

ED 265 831 Extending the human mind: computers in education. Proceedings of the Annual Summer Computer Conference. (4th, Eugene, Oregon, August 19-21, 1985) Oregon University at Eugene.
Ways Oregon educators have made use of computers. Three sections: curriculum, applications, learning and teaching, classroom and school management. Each major section divided into subject areas.

ED 266 646 Stevens, Vance.
Annotated bibliography of publications concerning computers in Education.
paper September 1985.
Annotated bibliography of material in the fields of education, languages, and linguistics, and computer technology. Journal articles, books, conference and workshop proceedings, booklets, and pieces from diverse publications. Unannotated bibliography focuses on computers in education and ESL/language learning. Resource guide listing organizations clearinghouses, journals, and periodicals, public domain software, vendors, catalogs, and upcoming publications.

ED 266 765 Connecticut State Board of Ed., Hartford.
A guide to computers in education: instruction.
Hartford, Conn: State Bd. Ed., 1985.
Guide to local school districts in planning for use of computers in classrooms both as a subject for study and as a tool for teaching and learning in other subjects. Goals and objectives, defining strategies for implementation, evaluation of equipment and programs, training the staff, establishing fiscal support.

ED 266 676

Brown, Eric, comp.
Assessing current programs and prospects. Report of Computer Assisted Language Learning workshop CILT.(Lancaster, England, September 13-14, 1983) Centre for Information on Language Teaching and Research, London)

Computer related developments in speech research, implications for therapy and communication, descriptions of courseware for grammar and comprehension instruction and language practice in English, French, German, and Spanish. List of current research projects in the field, courseware applications, hardware, etc.

ED 266 777

Parr, Leslie; Miles, Rich.
Computers in schools; a follow up report. Medford, Oregon: Jackson Education Service District, 1985.

Update of 1984 study of status and use of microcomputers in 2 counties of Oregon. Information on management programs used, student use of computers, resource people, staff training needs. Sample projects, 24 item list of suggested readings.

ED 266 903

Gittinger, Jack D.
Mobile CAI in rural New Mexico. Annual Southwest Conference for rural education (Las Crusas, NM February 14-15, 1986)

A 3 year CAI project establishing one mobile and five permament labs offerring vocational and remedial education. Originally developed for Israel's culturally diverse immigrants in educationally isolated areas. The mobile laboratory is appropriate for a rural state with minimum resources and I included it in this guide because developing countries have similar problems of rural areas and few resources and have used this idea for school education with computers.

ED 267 791

Seymour, Sherrie L and others.
Micros and continuing motivation. Annual Convention of the Association for Educational Communications and Technology (Las Vegas, Nevada, Jan. 16-21, 1986)

Study of two groups of students completing a learning task either with computer or paper/pencil and either with easy or hard difficulty levels. Of computer group, 97% wanted to do another task with computer; of paper/pencil group 1% wanted to do another task with paper/pencil. Students felt the task was more interesting with the computer, evaluated their own performance more highly, and had greater desire to study more of the same type

of subject matter.

ED 268 978 Lai, Kwok-Wing.
Applications of computers in Education in developing countries with specific reference to cost-effectiveness of CAI.
Ontario, Canada: M Ed thesis Queens University, Kingston, 1983.
To examine applications and cost-effectiveness of CAI for secondary education in developing countries. Definition of problem, nature of CAI discussed, its instructional capabilities and cost effectiveness, review of literature on cost effectiveness and costs in developed countries; general description of some educational problems in the Third World with specific reference to educational poverty, discussion of applications of computers in the developing countries, discussion of appropriateness there, etc.

ED 269 597 Using micros in Vocational Ed. to teach needed skills in the machine shop and related occupations.
Princeton, W. Va: Mercer County Schools, 1984.
Project to identify machine shop occupations requiring workers to use computers, edentify computer skills needed and determine which software products are currently being used in machine shop programs. There is a need to develop training systems for use in machine shop programs in W. Va to supplement programs with instruction in technical math.

ED 269 745 Henney, Maribeth.
Reading and computers: how teachers can make them work together. 1984.
Categorizes computer programs for education into two, software evaluation checklist listing programs that help facilitate the ease and efficiency of reading; describes two programs that combine teaching of reading and writing: Bank Street Writer and Story Tree.

ERIC Document Reproduction Service (EDRS)
Computer Microfilm Corporation (CMC)
3900 Wheeler Avenue
Alexandria, Virginia 22304
(800) 227-3742 or (703) 823-0500 (Virginia)

Conferences/Meetings

Cannings, Terence R. and Brown, Stephen. "Planning, implementing, and evaluating a Masters program in educational computing." Computers in Education: World Conference on Computers in Education (4th, Norfolk, Virginia, USA, July 29-August 2, 1985)

The focus to be educators, specifically teachers but to in-include industrial trainers and others directly involved in the instructional process. Goals, advisory committee, courses, requirements, evaluation of program.

David, Bertrand T. "Computer aided design education: an overview." (France) Computers in Education: World Conference on Computers in Education (3rd, Lausanne, Switzerland, July 27-31, 1981)
Comprehensive approach for development of a CAD education curriculum on different types and levels of education, teaching methods, etc.

Desgraz, Claude. "Informatics in the secondary school education of the Canton de Vaud." (Switzerland) Computers in Education: World Conference on Computers in Education (3rd, Lausanne, Switzerland, July 27-31, 1981)
Description of the present situation of informatics in Vaud Secondary school education, future developments.

Ferraris, M. and Sassi, E. "In-service teachers training in CAL: an experimental research." (Italy) Computers in education: World Conference on computers in education (4th, Norfolk, Virginia, USA, July 29-August 2, 1985)
Experimental intensive course for in-service high-school teachers to provide initial training in informatics and in educational software use and production.

Fraser, Rosemary; Wells, Colin; Burkill, Sue. "Eureka, Jane plus, and trans pots designing material for the microcomputer and teacher partnership in the classroom." (England) Computers in Education: World Conference on Computers in education (3rd, Lausanne, Switzerland July 27-31, 1981)
Four development phases in designing material for the microcomputer and teacher partnership; example of flexible teaching material and the importance of classroom observation.

Gulati, D.V. "Computer education and the needs of developing countries." (Kowloon, Hong Kong) Computers in education: World Conference on Computers in education (3rd, Lausanne, Switzerland, July 27-31, 1981)
Teaching computing as Computer Science covers some aspects of data processing but does not address the problem of acquiring applications from vocationally oriented professionals. An integrated model is suggested for creating special purpose facilities within each country adaptive enough to take into account each country's needs and adjust to environmental changes.

Hegazy, O.; Al-Akabaoui, M.S.; and Boshra-Riad. "Proposed curriculum for information science education in developing countries." Computers in education: World Conference on Computers in education (3rd, Lausanne, Switzerland, July 27-31, 1981)
Many developing countries will not be able to develop and produce their own hardware and software. They will have to find the best

ways to use or adapt existing information systems and technologies. They will have to provide adequate training systems and facilities to expose graduates to the state of the art in information technology with enough detail to provide the skills needed to make alterations.

Lalov, Boylan. "Methods of perfection and optimization of computer aided learning." (Sofia, Bulgaria) Computers in education: World Conference on Computers in Education (3rd, Lausanne, Switzerland, July 27-31, 1981)
Suggestions to improve the dialog between computer and student and implementation of them by computer aided learning programs.

Leiblum, M.D. "Factors sometimes overlooked and underestimated in the selection and success of CAL as an instructional medium." (Netherlands) Computers in Education: World Conference on Computers in Education (3rd, Lausanne, Switzerland, July 27-31, 1981)
CAL is often misused creating disappointments in the outcome. Various procedures and factors are identified to assist CAL decision maker in the selection and implementation of a CAL application.

Pain, Helen. "A computer aid for spelling error classification in remedial teaching." (Edinburgh, Scotland) Computers in Education: World Conference on Computers in Education (3rd, Lausanne, Switzerland, July 27-31, 1981)
Describes a program in remedial spelling which will detect and correct errors made by children when writing their own compositions. Errors are analyzed and a profile of errors are provided to the teacher.

Petrov, Nikolai; Medvedev, Valeri; Zykov, Michael. "The use of educational games in computer assisted learning." (Taganrog, USSR) Computers in education: World Conference on Computers in Education (3rd, Lausanne, Switzerland, July 27-31, 1981)
Psychologists state that most productive training takes place at an average (optimum) psychological level if it demands more action of a learner. Too high or low a level decreases the quality of intellectual activity. A game can help learners to be more active, helping them to come to alternate decisions during training, bringing in the element of contest. This can be accomplished by modifying current software.

Rogers, Jean B. and Austing, Richard H. "Computer science in secondary schools; recommendations for a one year course." (USA) Computers in Education: World Conference on Computers in Education (3rd, Lausanne, Switzerland, July 27-31, 1981)
Course intended for students at the secondary level. Emphasis is on the practical use of computers as tools for problem solving. Course goals and content specified. Implementation concerns, teacher training, equipment and software needs discussed.

Schiffman, Shirl S. "Designing a computer literacy curriculum: an integrated approach." Computers in Education: World Conference on

Computers in Education (4th, Norfolk, Virginia, USA, July 29-August 2, 1985)
Computer literacy program for 8th graders began in the Charlottesville School System, 1983. All teachers from the four basic disciplines (social studies, reading/language arts, science, and mathematics) participated with the responsibility for teaching the computer skills divided between all of them. Discussion of the philosophy of the integrated approach, inservice and curriculum development activities, and plans for the future.

Schlessinger, June H. And Schlessinger, Bernard. "Use of microcomputers in schools--library interaction with the subject areas." The application of mini- and micro-computers in informatinn, documentation, and libraries. Proceedings of the International Conference on the application of mini- and micro-computers in information documentation, and libraries (Tel-Aviv, Israel, March 13-18, 1983)
Micro-computers should be used in libraries, departments of English as well as Science and Business, and there should be co-operative projects between libraries and the Humanities teaching areas. (suggestions)

Vogel, Sally and Aiken, Robert. "A self-study guide in computer literacy for teachers." (USA) Computers in Education: World Conference on Computers in Education (4th, Norfold Virginia, USA, July 29-August 2, 1985)
Prototype of a self-study guide for teachers in computer literacy. Activities are related to the teachers' assessed concerns and interests. Teachers can proceed at their own pace based on their background and level of motivation.

Woodhouse, David. "Course integration." (Australia) Computers in Education: World Conference on Computers in Education (4th, Norfolk Virginia, USA, July 29-August 2, 1985)
Computer use in schools should have long-range planning with two objectives:

Integration into the curriculum.
Avoiding constant revision of the curriculum as technology evolves.

A new approach to assessing programming could help.

Zmud, Robert and Cotterman, William. "A national informatics educational strategy for developing nations." (USA) Computers in

education: World Conference on Computers in Education (3rd, Lausanne, Switzerland, July 27-31, 1981)

A national strategy is suggested to develop, reinforce, and evolve a system to expose the citizenry to informatics and make generally applicable information systems available to organizations via media campaigns, informatics application centers, extension services, and universities.

All of the above conferences were sponsored by the IFIP; International Federation of Information processors and place to purchase all three different conferences is to send to:

North-Holland
sole distributors in US & Canada
Elsevier North-Holland, Inc.
52 Vanderbilt Ave.
NY, NY 10017

One could go to the nearest library and fill out a request to borrow it through the library system. There would be a chance that the library might own it if the library is a university library.

One could also ask North-Holland, upon writing to them to purchase, for a list of other conferences dealing with computers, education, etc. that they have also published within the timespan desired.

Journals

These journals are appropriate not only for basic information common to all educational settings, regardless of country, but would be helpful in determining how to evaluate hardware, software, find sources which already do evaluate both, and mention some of the situations in school environments from country to country. These journals will be of use in obtaining information for each section of this paper, but will only be listed once, here.

AEDS Journal
Association for Educational Data Systems
1201 16th St., NW
Washington, DC 20036 (quarterly)

News, articles, and events regarding the use of computers in education.

AEDS Monitor
Association for Educational Data Systems
1201 16th St., NW
Washington, DC 20036 (quarterly)
subtitle: Computer-based technology in Education. Short articles on computers in education. Features "What's new in ERIC." Index to each volume in next issue.

Australian School Librarian
SLAV
Box 280
East Melbourne, Victoria 3002 (quarterly) $27.00
Deals with schools in public school-type settings and all surrounding issues, articles..

British Journal of Educational Technology
Council for Educational Technology
3 Devonshire St.
London, England W1N2BA
Articles on technology in education; more technical than some of the other journals. (does concern itself with computer use in schools) Has book reviews, lists meetings, etc.

Canadian Journal of Educational Communication
Association for Media and Technology in Education in Canada
500 Victoria Rd.
North Guelph, Ontario N1E6K2 (quarterly) $30.00
Contains reports, articles, etc. on all aspects of technology in education.

Classroom Computer Learning
P.O. Box 266
Cambridge, Mass 02138 $12.00/yr. (monthly)
Articles on the use of the computer in the classroom. Basically deals with K-12 levels of education.

Classroom Computer News
Intentional Educations
341 Mt. Auburn St.
Watertown, Ma 02172 bimonthly during school year
Use of computer-based learning along with traditional classroom instruction. Features: teacher developed classroom applications, articles with original programs, viewpoint column. Reviews on software and hardware.

Computer Equipment Review
Meckler Publishing Corp.
11 Ferry Lane West
Westport, Ct 06880 (semi-annually) lowest subscrip. $105.00

Computers and Education: an international journal
Pergamon Press/Maxwell House
Fairview Park
Elmsford, NY 10523 (quarterly)
Each issue has articles on education involving computer technology.

Computers in the Schools
Subscription Dept.
Haworth Press, Inc.
75 Griswold St.
Binghamtom, NY 13904 (quarterly) $24.00/volume indivs. ($30.00 inst.; $40.00 libraries)
Deals with computers in all levels of schooling.

The Computing Teacher
International Council for Computers in Ed. (ICCE)
University of Oregon
1787 Agate St.
Eugene, Oregon 97403 (9 issues/yr.) $21.50
Instructional use of computers. Articles concerned with teaching about computers, using computers, teacher education, and the impact of computers on curriculum.

Courseware Mag. now School Courseware Journal
School of Business and Administrative Services
California State University
1341 Bulldog Lane, Suite C
Fresno, Ca. 93740 (5/yr.) $80.00 includes software samples
Publishes documented educational programs for the Apple II, PET, and the TRS-80 microcomputers which can be used by pre-college students. Conferences, workshops, and computer-related class schedules.

Creative Computing
Ahl Computing Inc.
P.O. Box 5214
Boulder, Colo 80321 (monthly)
Information on personal computing applications, games, reviews, and resources. Educational uses of computers in each issue.

ECTJ (Educational Communication & Technology Journal)
Associations for Educational Communications and Tech., Inc.
1126 Sixteenth St., NW
Washington DC 20036 (quarterly) $24.00
Internaional journal of research and practice

Education in Asia and the Pacific
UNESCO Regional Office for Educationa in Asia & Pacific
P.O. Box 1425 General Post Office
Bangkok, 10500, Thailand (semiannually)
Reports and articles on educational issues; programs, computer use, book reviews, etc.

Educational Computer Magazine
Edcomp, Inc.
P.O. Box 535
Cupertino, Ca 95015 (bimonthly) $15.00
Educational use of computers.

Educational Technology
140 Sylvan Avenue
Englewood Cliffs, NJ 07632 (monthly) $69.00
Many articles concerned with computer use in education. (all levels); Other types of technology reported as well. (the reading is enjoyable)

Infoworld: the newsweekly for microcomputer users
375 Cochituate Rd.
P.O. Box 880
Framingham, Ma 01701 (weekly)
State of the art in microcomputing. Consumer information, microcomputing news, evaluates hardware and software, and reports on new developments.

Interface Age:
McPheters, Wolfe, and Jones
16704 Marquardt Avenue
Box 1234
Cerritos, Ca 90701 (monthly)
subtitled: Computing for Business. Covers broad spectrum of computer application. Do not need background in computer technology to enjoy. Specific issues deal with computers in education.

Journal of Computer-based Instruction
ADCIS/Computer Center
Western Washington University
Bellingham, Wa 98225 (quarterly) $18.00
Articles and reports on progress in aspects of computer education.

Microcomputer Index
Microcomputer Information Services
2646 El Camino Real #247
Santa Clara, Ca 95051 (Quarterly)
Guide to articles, book reviews, hardware and software reviews in more than 25 popular microcomputer magazines. Each issue has a subject index with bibliographical information; abstract section.

Microcomputers in Education
Queue, Inc.
5 Chapel Hill Drive
Fairfield, Ct 06432 (monthly)
The focus is on educational commercial software. New educational programs, software reviews, and summaries of software reviews from other magazines. Announces new products, publications, workshops, etc.

School Libraries in Canada
SLIC Subscriptions
Canadian Library Association
151 Sparks St.
Ottawa, Ontario K1P5E3 (4/yr.) $35.00
Deals mainly with education on Elementary and Secondary levels and equipment used there.

Small Computers in Libraries
Graduate Library School
University of Arizona
1515 East 1st St.
Tuscon, Az 85721 (monthly)
Internal and public access library applications of micros/clearinghouse. Glossaries, tutorial articles, reviews books and programs, reports on uses of computer management systems.
(also a mag. with same name put out by Meckler Corp., 11 Ferry Lane W., Westport, Conn. 06880--monthly--$39.50/yr)

Software News
Sentry Publishing Co., Inc.
1900 West Park Dr.
Westborough Office Park
Westborough, Ma 01581 (monthly) $40.00

Teaching and Computers
Scholastic, Inc.
730 Broadway
New York, New York 10003 (8 issues) $19.00/yr.
Elementary and Secondary School computer information, software programs, etc.

III. Selection and Evaluation of hardware with emphasis on the international setting.

A. Brief explanation of Microcomputer components.

There are six elements in a microcomputer:

1. Input- How the information comes into the system. Most commonly, the device used is the keyboard. A few others include: calculator-style numeric pads, game paddles, joysticks, light pens, speech recognition systems, and card readers.

2. Output- the means used to reply with the information. Most micros use a television-type screen; many also have a printer to make "hard copy" of the information. Other systems: plotters or remote control systems for turning lights, etc. off and on from a distance.

3. Central Processing Unit- the brain of the computer. In a micro, a CPU is a microprocessor. (a single integrated circuit or chip)

4. Memory- There are two types of memory in today's computers:

a) RAM: Random Access Memory- device that can be set to any value, read back as many times as wanted, and changed at will(which is taken care of by the CPU)

b) ROM: Ready only memory- device that is permanently "burned" with the information that the computer will use a lot (example: the BASIC language interpreter which allows the computer to run user programs written in BASIC is often built into a micro in ROM)

5. Storage- With RAM, once the computer is turned off, everything is forgotten or erased. To prevent this loss and to provide room for more data than the memory can store, there are systems for recording programs and files and retrieving them. Two common ones:

a) Data Cassettes- like audio cassettes but recorded with buzzing tones that the computer interprets as bits and bytes. Most micros use a regular audio cassette machine but some brands have a special recorder. Cassettes only work sequently (reading the entire file from start to finish) and are slow.

b) Floppy Diskettes- flat surfaces of magnetic recording material shaped like a 45 record. The diskette goes into a disk drive which spins the disk surface while a read/write head slides from center to rim reading or recording data in a series of concentric tracks. The diskette has a random access storage system so the computer can read any part of the diskette. This system is much faster than the other.

6. Software- the previously mentioned elements comprise the hardware of the computer system or physical equipment. The computer needs a program to run on it. Programs being sets of instructions that tell a computer how to do something. (example: calculate an equation, print a report, teach a student, etc.) Programs are called software and can be written by the user or purchased already recorded on diskette or cassette. Software for one brand of micro generally will not work on another brand. Peripherals are devices or attachments to a microcomputer that are not part of the basic package. These can differ form brand to brand. Examples: printers, card readers, and joysticks.

B. Basic evaluation method for hardware selection.

Generally, the first thing one must consider is how the equipment will be used. That is, what are the goals of your educational program us-

ing the computer? After you define the applications or software that you need to support your planned program, the hardware choice can be determined.

Next, one must decide if one brand of microcomputer can meet all of the requirements. One advantage with a single brand is that standardization will allow an exchange of software and hardware parts making maintenance arrangements much mor simple. It is also easier to deal with one service company than several.

Next, the evaluative criteria must be weighed. These are:

1. Cost- Send out a request for information, RFI, to all poetntial bidders and then check on the prices of more than one minimum configuration available from each vendor (example: 16K black/white monitor) because some manufacturers increase the price of peripherals to offset the edge they have in minimum configuration bidding. If you are buying a large number of computers, insist on some kind of discount. Specify that the bidder include all cables and connectors to set up and operate the computer.

2. Hardware & basic Software- factors such as central processing unit performance, disk capacity, disk operating system (DOS) capability, expandability (can this be upgraded to increase the memory?), are there a wide range of peripherals to increase capabilities?, languages (are languages besides BASIC available? PASCAL and PILOT are better for CAI lessons), and user interface- is the computer designed with the student in mind? (equipment being durable, video display easy to view and safety features such as a cover on the microprocessor that locks to prevent tinkering with the inner circuitry)

3. Software- Vendors should provide a list of software available in the areas of microcomputer use. Ordering information should be included.

4. Maintenance- accessibility to service is important. Vendors can bid on differenct service options. For example, walk-in, pick-up, and delivery, and on-site service. Ask for an extended warranty plan beyond the 90 days such as 9-12 months. Also, a list or organizations previously serviced would allow you to check on the satisfaction of previous customers. If possible, support your local computer dealers so that the dealer who made the original sale will also service the computers. Without convenient maintenance service it won't be worth buying the computers.

5. In-Service Training Support- the importance of this must be stressed in bid specifications. Find out about the manuals and support materials, how many days of consultation will be provided for training. Request a toll-free number for questions and samples of training materials- you should see them. The vendor's longevity and reputation are important considerations.

C. Sources for selection and evaluation of hardware with emphasis on international resources.

Readings

Berry, John. "Library use of microcomputers : massive and growing." Library Journal 110 February 1, 1985 : 48-9.

Library Journal
RR Bowker Co.
Subscription Dept.
P.O. Box 1427
Riverton, NJ 08077 to purchase back copies

Survey concerning the number of microcomputers in use in libraries, the most popular brands, software, etc.

Blair, John C. Jr. "Micros, minis, and mainframes : a newcomer's guide to the world of computers -- especially micros." Online 6 January 1982 : 14-26.

Discusses differences in all three types of computers, suggests selection procedures for hardware and software, describes variety of applications.

Online, Inc.
11 Tannery Lane
Weston, Ct 06883 purchase of back issues

Billings, Karen and Glass, Stephen. "Rating the microcomputers : what experts have to say." Electronic Learning 1 (3) Jan-Feb 1982: 39.

Lists ratings of microcomputers in eleven different categories by prominent educators who use microcomputers.

Electronic Learning, Scholastic Inc.
902 Sylvan Avenue
Box 2001
Englewood Cliffs, NJ 07632 purchase of back issues

Braun, Ludwig. "Help !!! What computer should I buy?" The Mathematics Teacher 74 (8) November 1981 : 593-8.

Basic guidelines in deciding which computer to buy. Gives method for comparing computers by considering uniqueness of each educators needs.

Mathematics Teacher
National Council of Teachers of Mathematics
1906 Association Dr.
Reston, Va 22091

Gorden, Helen A. " A guide for reading: aselected annotated bibliography for understanding microcomputer hardware, software, and peripherals. Online 7 (3) May 1983: 30-34.

Bibliography of articles on Microcomputers, software, printers, modems, and disk drives.

address for Online given previously this section.

Mason, Robert M. "Choosing a microcomputer: a success story." Library Journal 108(4) February 15, 1983: 356-58.

Suggests a needs assessment and a situation assessment to help decide what to buy and from whom to buy it.

address for Library Journal given previously this section.

Williams, Gregg. " A closer look at the IBM personal computer." Byte 7(1) January 1982:36-68.

Favorable review for IBM personal computer. Covers color graphics, system specifications, BASIC langauge, benchmark tesks, documentation, and current weaknesses.

Byte
70 Main Street
Peterborough, NH 03458

Books

Since many foreign countries use the same microcomputers that are in use in the U.S., either by import or by having factory locations of within, there will be U.S. hardware guides listed as well.

Audiovideo Marketplace, 1985-85: a multimedia guide.
NY: RR Bowker, 1986.
$49.95
Producers, distributors, and services for Hardware, software, Video, Cable programming, sound recordings, music scoring, music and sound effects libs., other equipment manufacturers, unions, guilds, periodicals, reference books, and associations. U.S. & Canada.

RR Bowker Co.
P.O. Box 1807
Ann Arbor, Mi 48106

Doak, Wesley A. and Speed, William J. eds.
International Index to multimedia information.
Pasadena, Ca: Audio-Visual Associates, 1986.
Indexes more than 400 audiovisual magazines and producers. Annual directory organized by subject, title, medium to evaluate whole range audiovisual and nonbook media. International.

Audio Visual Associates
180 E. California Blve.
Pasadena, Ca 91105

International Referral Center for Information handling equipment. (IRCIHE)
International directory of suppliers and agents for information handling equipment and logistical support services.
Zagreb: IRCIHE, Referral Centre of the University of Zagreb, 1985.

IRCIHE
Referral Centre of University of Zagreb
P.O. Box 327
41001 Zagreb, Yugoslavia

Henderson, Faye W. and Chase, Leslie R.
Annual directory fo the information idustry information sources, 1985.
Washington DC: Information Industry Assoc., 1985.
International listing of database producers and vendors of computer hardware, information retrieval services, information brokers and retailers, market researchers, periodical and newsletter publishers, information technology and computer software producers, videotex, teletext, etc.

Information Industry Assoc.
316 Pennsylvania Ave SE suite 400
Washington DC 20003
(202) 544-1969

MMP 1986: Microcomputer marketplace
New York: RR Bowker, 1986
$95.00
In-depth listing for distributors, manufacturers of hardware, software, peripherals, and supplies; meetings and exhibitions, magazines, newsletters, associations and addresses, directory of microcomputer executives, market researchers, reproduction services, software developers, etc. (US & Can.)

R.R. Bowker Co.
Order Dept.
P.O. Box 1807
Ann Arbor, Mich. 48106

Microcomputers for libraries: product review and procurement guide.
Powell, Ohio: James E. Rush, 1984.
0-912803-10-X
Contains background on microcomputers: historical and explanatory. Available hardware, hardware manufactures, software, software vendors, and peripherals. (US)

James E. Rush Assoc., Inc.
2223 Carriage Rd.
Powell, Ohio 43065-9703
(614) 881-5949

Online Terminal/Microcomputer guide and directory 1982-83.
Weston, Ct: Online, Inc., 1982.
Terminals and micros: selection criteria; directories of brokers, manufacturers, consultants, sales and services sources.

Online, Inc.
11 Tannery Lane
Weston, Ct 06883

Burton, Paul F. and Petrie, J. Howard.
Introducing microcomputers: a guide for Librarians
Wokingham, Van Nostrand Reinhold, 1984.
Introduction to microcomputers in libraries from the British perspective; development and technology, operating systems, hardware and software selection, etc.

Van Nostrand Reinhold div. of
International Thomson Organization, Inc.
115 5th Ave.
NY, NY 10003
(212) 254-3032

EPIE Reports.
Stony Brook, N.Y.: Education Products Information Exchange Institute, annual.

EPIE non-profit consumer agency for educational products; collects, evaluates information on performance and effectiveness with learners. A number of EPIE reports are issued each year. Some deal with materials and programs and others with equipment.

EPIE Institute
P.O. Box 620
Stony Brook, N.Y. 11790
(516) 246-8664

ERIC Documents

ED 205 203 Douglas, Shirley and Neights, Gary. "Micro-computer reference: a guide to micro-computers."
Arlington, Va : ERIC Document Reproduction Service, 1980.

General information about micro-computers, how to conduct a needs assessment, criteria for micro-computer selection.

EDRS address p. 19

Conferences

Stokes, Adrian V. "Characteristics of micros and their applications." Minis, micros, and terminals for libraries and information services. Proceedings of the Conference organized jointly by the Institute of Information Scientists and the Information Retrieval Specialist Group of the British Computer Society at the National Computing Center (Manchester, England, November 6-7, 1980)
Chichester: Heyden, 1981.

Brief history of the micro-computer, developments, production, and manufacture.

British Computer Society
13 Mansfield St.
London, UK W1M0BP

Palmour, Vernon E. "Planning automated information systems." The application of mini- and micro-computers in information, documentation, and libraries. Proceedings of the International Conference of mini- and micro-computers in Information Documentation, and libraries (Tel-Aviv, Israel, March 13-18, 1983)
New York: North Holland, 1983.

Process for planning and implementing small systems. Bib.

North-Holland address p. 22

Clearinghouses/Resource Centers

International Referral Centre for Information Handling Equipment (IRCIHE)
P.O. Box 327
41001 Zagreb Yugoslavia

Technical Education Research Centers (TERC)
Computer Resource Center
8 Eliot St.
Cambridge, Ma 02138
(617) 547-3890

Information on microcomputer hardware and software and library of technical and educational publications. Maintains microcomputers and educational software for inspection and sample use. The Center conducts workshops on classroom computer use.

Small computers in libraries
Dr. Allan Pratt, ed.
Graduate Library School
College of Education/U. of Arizona
1515 E. First St.
Tuscon, Az 85271
(602) 626-3566

To act as a clearinghouse for sharing of information on microcomputers in Libraries. Offers guidance in the form of glossaries, short tutorial articles, review of programs and hardware; books pertaining to the subject.

IV. Selection and evlauation of computer software with an emphasis on the international setting.

A. Brief explanation of software components.

The process of choosing a computer system should start at the software end. First decide what use will be made of the computer, then identify and price the software necessary to perform those tasks. (followed by hardware selection) There are 2 basic types of software:

1. Applications software- makes the computer useful in doing tasks we want done. For example, there are programs to handle tasks like averaging numbers and printing payroll checks. This software releases the user from doing trivial operations which are done inside the CPU.(computer averages the numbers, we get the end result)

2. Systems software- is applications software for programmers and handles the trivial operations on the CPU level making it easier to write programs to perform needed applications. For example, they allow the computer to be shared by several users at once, provides efficient management of files on disk drives, and allows use of computer languages. Systems software consists of:

a) Operating System Programs (sometimes a part of the language translator)- allow the user to rum programs and control the movement of data to and from the computer memory and peripherals. An example is a disk operating system, DOS, which allows you to name disk files, obtain a directory of those names, and copy files from the disk to another peripheral device. It keeps track of where all the files are on the disk. Operating system utilities (which may be separate from the system program) may include a program to copy the contents of one disk to another, a program to reformat new disks, a text-editor function to help type in and change programs, and an Assembler which is a primitive language translator which makes it easier to give directions to the CPU. You can give an assembler a mnemonic instruction like ADD and let the assembler translate it into a binary code. Assembler languages are low level languages because they are closely related to actual operation of the CPU.

b) Utility Programs- a function may be a part of the main operating system program or in a separate utility program which handles the operating system utilities explained above.

c) High-level language translators- high level languages are apart from the operation of the CPU (example: FORTRAN, BASIC, COBOL, APL, LOGO). An instruction in a high level language may start several CPU level instructions. There has not been a language written yet that performs as well as an assembler. The two types of translators are:

1. Compilers- (an assembler is a special kind of compiler) Most of the high-level languages are compiled. What occurs is this: the user writes a program in a high level language such as FORTRAN and stores the program which translates the original program into machine code and stores the program in a file. The user runs a FORTRAN compiler program which translates the original program into machine code and stores the code in another file. After this, the user tells the computer to load the machine code file into its memory and execute it.

2. Interpreter- is loaded into the memory (for example, a BASIC interpreter), gives the interpreter a BASIC program to run. The interpreter translates and executes the program one line at a time. If

you intend to run the program a lot, it is better to write it in a compiled language because the interpreter repeats the translation process every time the program is run.

B. Basic evaluation method for software selection.

The components of software selection and evaluation are:

1. Look for local sales and service - Every piece of software will generate questions. Someone familiar with the software on a technical level must be available to answer questions and fix the bugs in the software. Ideally the person will be in your local area, know you and your equipment, know your needs, and have sold you the hardware, software, and maintenance contract. If not, the next best thing is telephone support from the company that produced the software. A training session from a person familiar with the software can save a lot of time and trouble.

2. Buy software that does what you need it to do with least amount of difficulty. Many differences in quality and performance are hidden under similar packaging. You will want a package with flexibility to fit your needs, but be open to the idea that a package may be a better approach than the one you thought out.

3. Read the documentation for the software. Before the demonstrations, read the documentation. Good quality documentation indicates a good quality product.

4. Thoroughly test the software. A full dress demonstration of the package will suggest questions that you didn't think of to ask. Some characteristics that make a software package easy to use:

a) Is the software accident-proof? Some programs are not protected from accidental keystrokes. For example, if a game asks for a Y or N reply and a wrong key is struck, do you have to start the whole program over?

b) Are the directions simple and easy to understand? Some programs give just enough information to complete a certain task and introduce other sequences later when the user is comfortable with the simpler commands rather than introduce all the shortcuts and possibilities that a program allows at once.

c) Are the instuctions presented through the computer as an interactive mode? When the instructions are mediated throught the computer rather than through a printed manual, the software is easier to use. A tutorial program with monitoring of responses by the computer to accomplish a task make the tutorial effective.

d) Is there a continuously displayed instruction window? A small window displaying special keystrokes and even some directions can be very helpful. In simple programs with a limited range of possible responses, the lack of a continuously displayed menu may be a minor thing, but in complex programs a continuously displayed menu is much more important.

e) Does the program provide help following an incorrect response? Sometimes the user does not realize the common error he made. If the program can provide a prompt for these, it would save a lot of time in searching for the problem.

5. Demand fast and flexible data retrieval. The retrieval of information should be quick and indicates excellent file design and handling.

6. Buy software that makes the computer do the work. If you are aksed constantly by the program to change disks or tapes or re-enter information more than once it could mean the hardware is inadequate, the software is anedequate, or both.

7. Look for software that runs on different hardware. Someday you may replace your computer. It would be advantageous to be able to move software to the new computer without expensive conversion.

C. Sources for selection and evaluation of hardware with emphasis on international resources

Readings

Gordon, Anitra and Zinn, Karl. "Micro-computer software considerations." School Library Journal (28) August 1982, 25-27.

School Library Journal
R.R. Bowker Co.
P.O. Box 1427
Riverton, NJ 08077

Kingman, James C. "Designing good educational software." Creative Computing 7 (10) October 1981: 72-81.

address given p. 23

Nicholson, R. and Scott, P.J. "Computers and education: the software production problem." British Journal of Educational Technology 17 (1) January 1986, 26-33.

address given p. 24

ERIC Documents

ED 205 201 Douglas, Shirley and Neights, Gary. "Instructional software selection: a guide to instructional micro-computer software." Harrisburg, Pa: Pennsylvania State Dept. of Ed., 1981.
Hardware/Software interface sheet to determine whether the software to be evaluated is compatible with the hardware it is to be used on. Another form for instructional objectives, grade level estimates, validation data, instructional objectives, grade level estimates, validation data, instructional strategies, etc.

ED 243 455 Computers in the new curriculum. proceedings of the Annual Conference of the Texas Computer Education Association (4th, Austin, Texas, February 29-March 3, 1984)
63 papers on technology and its effect on the educational process at all levels. Automated instructional management, computer literacy, software evaluation, beginning a computer program, finding software, etc.

ED 253 220 A technical assistance report on Computer Technology Applications. Smithville School District, Smithville, Ma Merrimack Education Center, 101 Mill Rd., Chelmsford, Ma 01824 ($9.75)
Information for use in planning computer technology

applications over 3 year period with specific guidelines and criteria for planning and development, equipment consideration, software and courseware, etc.

ED 260 561 Evans, Robert J.
How school systems should purchase microcomputers; the software evaluation method, 1985.
Three major concerns are associated with micro-computers in educational settings:
1. Computer use.
2. Software selection.
3. Hardware selection.
Advantages and limitations noted. Software evaluation is considered in terms of external and internal evaluations. practical aspects of hardware evaluation offerred including costs and compatibility. Sample software evaluation form.

ED 261 566 Courseware evaluation checklist approved by the American Council on Education's Commission on Educational Cred and Credentials. (Sept. 24-25, 1984)
American Council on Ed., 1 Dupont Circle, Suite B-20, Washington DC 20036 $2.50
A checklist for evaluating courseware. Since most courseware is relatively new and untested, it is important to evaluate whether it functions effectively in helping learners achieve announced course objectives. Covers: user manuals, quality in sequencing subject matter, records on the prior use of material, instructor's role, extent of mechanical feedback, user control over learning process, etc.

ED 262 813 IFLA General Conference, 1985. Division on Management and Technology. Section on Information Technology.
IFLA, The Hague (Netherlands).
papers on information technology; one presentation was on software evaluation: sources and resourses in the UK.

ED 266 489 Hitchcock, Richard B.
Software jungle: guidelines for evaluating English computer programs. Annual meeting of Developmental Studies Conference (9th, Athens, Ga, April 1984)
Criterial for evaluating in these areas: instructions, user control, screen format, graphics, data handling, reinforcement, purpose. Sample courseware evaluation form.

ED 268 340 Software buyer's guide. Region X Adult Education Software Consortium, The Dalles, Or (April 1, 1986)
For adult education, but criteria would be applicable to any level program. Recommendations for core program and for larger program; software programs with annotations, curriculum guide, price guidelines, publisher's addresses. Sample blank rating form. programs for Apple computers.

ED 268 983 Harris, Martin L. and others.
Guidelines for educational software in California schools. California State Dept. of Education, Sacramento, 1985.
To provide guidance to teachers and other educators with the responsibility for selecting educational software. Guidelines are organized into 3 sections: essential attributes, desirable attributes, and indicators of excellence. These are further subdivided into educational content, technical features, and support materials.

EDRS address p. 19

Books

Classroom Computer-learning Directory of Educational Resources 1983-1984. 2 vols.
Belmont, Ca: Classroom Computer Learning, 1983.
Information on educational computing and a directory of educational software. (US)

Classroom Computer Learning
19 Davis Drive
Belmont, Ca 94002

Evaluator's guide for micro-computer based instructional packages developed by MicroSIFT which is a project of NW Regional Educational Laboratory, 1984.
Booklet with summary of MicroSIFT's evaluation process with detailed descriptions of all review components, review forms, sample reviews, and a glossary.

ICCE
Dept. 58
U. of Oregon
135 Education
Eugene, Or 97403

Glossbrenner, Alfred. How to buy software: master guide to picking up the right program.
NY: St. Martin's Press, 1984.
Hardware and software selection techniques; where to buy software, obtain free software, how to pick the best package from among the different types.

St. Martin's Press
175 5th Ave.
NY, NY 10010

Graham, John and Wygand, Roy, eds. International microcomputer software directory, annual 1981-
Fort Collins, Co: Imprint Software Ltd.
Listing of new and established software (over 5000 progs.) Available for all systems and applications; arranged by prog-

rams for specific computers, categories of programs and by supplier.

Imprint Software, Ltd.
420 So. Howes St.
Fort Collins, Co 80521

Keren, Carl and Sered, Irina.
International inventory of software packages in the information field.
Paris: UNESCO, 1983.
This inventory is the result of a survey of 188 software packages available in the field of information services. It has been prepared through the UNESCO General Information Programme in response to requests for guidance in selecting appropriate software. (particulaty from the developing countries)

UNESCO
7, Place de Fontenoy
75700 Paris

Lathrop, Ann. The Digest of software reviews: Education.
Fresno, Ca: Digest for Software Reviews: Education, 1984.
Instructional programs for Apple, Atari, Commodore, IBM, TI, and TRS-80 reviewd in more than 60 journals and newsletters. (over 200 selected programs)

Digest of Software Reviews : Education
1341 Bulldog Ln suite C
Fresno, Ca 93710

Nolan, Jeanne M.
Microsoftware evaluations 1985 (V. II)
Westport, Ct: Meckler Publishing, 1986.
Evaluations and full descriptions of leading software programs by various professionals with general guidelines in choosing a software package for a specific situation.

Meckler Publishing
11 Ferry Lane West
Westport, Ct 06880

Online Microsoftware guide and directory 1983-84.
Weston, Ct : Online Inc., 1982.
Feature articles by professionals in the field to assist in software selection specifications for over 730 software packages and comparison charts for popular programs. A list of microcomputer software publications and services, index to producers and annotated bibliography.

Online Inc.
11 Tannery Lane
Weston, Ct 06883

PC Telemart VanLove's IBM Software Directory.
NY: R. R. Bowker Co., 1984.
Massive collection of programs for the IBM PC User.
$24.95

R.R. Bowker Co.
P.O. Box 1807
Ann Arbor, MI 48106

The Software Catalog (for microcomputers)
NY: Elsevier, 1986.
0-444-00745-8
Produced from the International Software Database. Continuously updated reference service for information on available software applications, prices, and compatibility.

Elsevier Science Publishing Co., Inc.
52 Vanderbilt Ave.
NY, NY 10017
(212) 867-9040

The Software Encyclopedia 1985/1986.
NY: R.R. Bowker Co., 1985.
0-8352-2155-8
Software packages from all areas of the software industry. Applications, titles, and publishes.

R.R. Bowker
205 E. 42nd St.
NY, NY 10017

T.E.S.S. The Educational Software Selector, 1984.
NY: Teachers College Press, 1984.
Compiled by EPIE Institute
0-8077-2760-1
All educational software being marketed to schools and colleges for use on micro-computers. Software package descriptions, contents of the packages, summary listings by hardware system, software suppliers.

EPIE Institute
Box 839
Water Mill, NY 11976
(516) 283-4922

Wang, Anastasia C., ed.
Index to Computer Based Learning. (3 vols + Index)
Wisconsin: Educational Communications Div., 1982. (annual)
Computer based learning software programs for Junior High-College level.

Educational Communications Div.
U of Wisconsin
P.O. Box 413
Milwaukee, WI 53201

I would like to mention that the Asian Computer Yearbook covers computer products and services for Asian countries. It is published in Singapore, but I don't have the rest of the address.

Conferences

Aston, Mike and Squires, David. "Software tools for curriculum change implications for teacher education." Computers in Education: World Conference on Computers in Education (Norfolk, Va, USA, July 29-August 2, 1985)
Good educational software is needed for programs in the primary and secondary school systems along with teacher education and curriculum change. Survey of some models of good programs adopted in Britain. (update of survey in 1981)

Aston, M.H. "Towards an integrated apporach to distribution of educational software." (UK) Computers in Education: World Conference on Computers in Education (Lausanne, Switzerland, July 27-31, 1981)
The growth of microcomputers calls for packages to use across the curriculum in the classroom and the home. Several distribution models are being tried in the UK. Three of the most widely used models examined.

Coleman, M.J. "Teacher-oriented educational software." (UK) Computers in Education: World Conference on Computers in Education (Norfolk, Va, USA, July 29-August 2, 1985)
Current developments of software for schools have focused on the needs of the pupil. In this paper, it is argued that equal emphasis must be given to the needs of the teacher.

Egerton, Luella. "A model for the production of exemplary educational software three years experience." Computers in Education: World Conference on Computers in Education (Norfolk, Va, July 29-August 2, 1985) (Can)
Plan to fund the development of quality computerized learning materials for Ontario elementary and secondary schools. Software production model, its results, and the revised model presently in use.

Otsuki, Setsuko and Takeuchi, Akira. "Unified CAL system for authoring, learning, and managing aids." (Japan) Computers in Education: World Conference on Computers in Education (Lausanne, Switzerland, July 27-31, 1981)
BOOK system proposed which is a CAL utility composed of different software tools to help author CAL materials and help systematize all CAL materials in a similar way with a CAL language called BOOK.

Preece, Jenny and Jones, Ann. "A distance learning pack for training teachers to assess software." (UK) Computers in Education: World Conference on Computers in Education (July

27-31, 1981)
It is not necessary for teachers to learn to program, it is essential for them to know enough about program design to develop a framework within which to judge educational software. This paper describes an open university course that trains teachers to be critical software consumers.

Wang, Jiqing, Zhang, Qinzhu, and Zhang, Huakua. "A micro-computer-based instruction system--basic programming instruction." (China) Computers in Education: World Conference on Computers in Education (Lausanne, Switzerland, July 27-31, 1981)
MCBBI, a micro-computer based BASIC instruction system, is a self-taught system adaptable to non-computer specialist students.

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clearinghouses

MicroSIFT
NW Regional Educational Laboratory
300 SW 6th Ave.
Portland, Or 97204
(503) 248-6800
Clearinghouse for K-12 software reviews. Established procedures for collection and evaluation of instructional materials and information.

Minnesota Educational Computing Consortium (MECC)
2520 Broadway Dr.
St. Paul, Mn 55113
(612) 638-0610
Established in 1973 to co-ordinate and provide computer and educational services to students, teachers, and educational administrators in Minnesota. Develops micro-computer courseware; in-service training for educators and materials for conducting training; instructional computing assistance through newsletters, micro-computer purchase contracts; technical support.

Softswap Micro-computer Center
San Mateo County Office of Educ.
333 Main St.
Redwood City, Ca 94063
Variety of micro-computers housed here and a number of commercial software programs available for preview. The center has a large amount of public domain software which is available for free if you bring own disks to copy. For a complete catalog and ordering information send $1.00 to Ann Lathrop at Softswap.

V. The difference between the school environment in the U.S. and other countries: Industrial, Newly Industrial, and Developing.

A. Treatment of the three types of development.

The U.S. will be used as the primary example of an Industrialized country and how the new technology of micro-computers has been incorporated into the educational setting. Since I have come across some additional sources of information dealing specifically with England, I will include them at the end of the U.S. information. Some of the sources that I will be using will contain information on countries that cut across the three divisions. In this instance, I will list the source where I need the information most, but I will list all of the countries on which there is information in each source so that if one is interested in a country that I am not using as a primary example, he/she may determine which source contains that information and locate the document containing the information of interest. If I have additional sources of information on countries which are not primary examples, I will list them at the end of the appropriate section.

B. The school environment in the U.S. (Industrialized)

1. Computer/CAI background information for the U.S.

The development of the first electronic general purpose computer in the U.S. was ENIAC, the Electronic Numerical Integrator and Calculator financed by the U.S. Army in 1946. It was built by J.P. Eckert and J.W. Mauchly at the Univ. of Penn. ENIAC and the first generation computers (1953-1960) such as UNIVAC, IBM 704, RCA Bizmac, and Honeywell D-1000 were large bulky machines using vacuum tubes and electronic relays to process and store information received by punched cards or magnetic tape. Memories were small (couldn't store programs) and the computers needed machine language programs.

The second generation of computers (1959-1964) used transistors instead of vacuum tubes which needed only a fraction of the power and took up less space. In addition to transistors, these computers used very small electromagnets for primary memory storage.

The third generation of computers having solid-state circuitry became available in 1965. In 1971, the Intel Corporation announced the invention of the first microprocessor.

Computerized instruction began in the early 1960's which used large mainframes connected to single terminals in distant locations leading to many bad experiences. Some of the important commercially based experiments in the U.S. were conducted by:

a) IBM (International Business Machines)- in 1958, developed a computer program to teach binary arithmetic; 1961, researched CAI in the areas of stenotyping, psychological statistics, and German reading; 1966, worked on a programming language for instructional applications requiring machine-student dialogue (COURSEWRITER) and developed System 1500 which had 32 student stations each with a display terminal, image projector, and audio equipment.

b) SDC (Systems Development Corp.)- part of the Rand Corp. It's project, CLASS, Computer-based learning for automated school systems, tried to develop a computer-based instructional system to cover the entire educational process. (administration, counseling, individual and group instruction)

c) TRW (Thompson, Ramo, Wooldridge, Inc.)- developed the MENTOR automatic tutoring device which scored student responses, made decisions based on these responses, selected presentations and controlled the conditions of the presentations. MENTOR was a stand alone teaching machine unable to interface with other aspects of the educational process lie CLASS could.

d) BB & N (Bolt, Beranek, and Newman)- developed drill and practice applications of paired associate items in German vocabulary.

Important educationally-based efforts were:

a) Stanford University- patrick Suppes' work in elementary math and reading computer-based teaching. Starting in the early 60's with one teacher and 41 students and expanding to a large number of California school districts as well as elementary schools in Mississippi.

b) University of Illinois- Donald Bitzers PLATO project which connected one interactive terminal to the U of Ill's. ILLIAC I computer. PLATO grew into a large computer network with extensive capabilities. Instructional materials were created by interested faculty and staff with support from a small group of professionals. PLATO is now distributed commercially by Control Data Corp. for educational and non-educational applications. PLATO is an instructionally-oriented interactive computing system using one large central computer.

c) Brigham Young University -- University of Texas- in 1971, the design and implementation of a mini-computer based CAI system called TICCIT was completed. It has computer and television technologies and has a team of professional designers and programmers to produce courseware. It is now commercially produced.

d) University of Iowa- CONDUIT- CONDUIT has tried to develop CAI programs that can be "transported" between systems. This includes minimal versions of programming languages with only the most easily transported commands. CONDUIT acts as a clearinghouse and publisher in providing support and translation services to authors. It reviews, tests, and markets the materials. It is a reliable source of information and materials for CAI instruction.

e) MECC (Minnesota Educational Computing Consortium)- The state of Minnesota provided funds to support this state-wide consortium of schools and universities to promote the development and exchange of instructional computing materials among the different institutions. MECC is a model of this activity for the nation and a source of commercially availabel CBE material. It is responsible for legitimizing the entrance of the micro-computer in the minds of educators.

School administrators in the U.S. are faced with an increased demand for students to have experience with computers at school. Many schools are involved with production o micro-computer based CAI materials, but ways to publish and expand them have not yet developed. A survey of the 1984-85 school year in the U.S. on micro-computer use in school districts was taken by Market Data Retrieval. From 1983-84 to the next school year, there has been a 75% increase in all kinds of elementary and secondary schools. 85.1% of the public schools have them for instructional use; 63.4% of the Catholic schools; 46.4% of the private schools; High schools are 93.1% for instructional use; Junior Highs are 93.1%; Elementary Schools are 82.2%.

C. Sources for information on the school environment in the U.S.

ERIC Documents

ED 246 886 Johns Hopkins University. Center for Social Organization of Schools. "School uses of micro-computers: Reports from a National Survey. Issue no. 5."
Alexandria, Va: ERIC Doc. Reproduction Service, 1984.
The location of the computer equipment determines the effectiveness it has. Study compares micro-computer usage when equipment is located in classrooms, library-media center, in micro-computer labs, rotated from room to room, and dispersed throughout the building where needs are identified.

ED 248 306 Lipkin, John. "Equity and micro-computer use in American public education." ECS working paper, LEC-83-15. Educ. Commission of the States, Denver, Co Law and Educ. Center, 1983.
Computer literacy is becoming a key element in a child's education and future success. Evidence shows that access to micro-computers is more limited for the poor and minority student than the wealthier majority student; female students may not participate in advanced programs for math., science, and related activities to a degree that males will. More computers are being purchased in wealthier districts with more sophisticated student-computer interaction. Review of potential assistance that Federal and State governments can provide in order to achieve equity.

ED 253 202 Gardner, Marilyn. "Computer education: a system-wide approach. Annual convention of the American Vocational Assoc. (Anaheim, Ca., Dec 2-6, 1983)
Boston: Boston public Schools, 1983.
Based on experiences of the Boston public Schools, paper offers guidance in organization and development of a system-wide approach to expansion of computer technology.

ED 259 702 Stoneberg, Bert Jr. "Computer-Assisted Instruction, Rep. to the Board of the Greater Albany Public School District no. 8J Ore, 1985."
Findings of an evaluation in the Greater Albany public School System, Or to determine the effects of CAI in math.

with WICAT System 300 at the Periwinkle Elementary School. Rep. has an executive summary and 5 sections. The majority of the findings indicate that achievement scores improved significantly with the most dramatic improvements for the 2nd graders. Students, parents, and staff gave CAI high ratings.

ED 260 696 Burkholder, Jana M. Annotated bibliography of the literature dealing with teacher training in the uses of the computer in Education, 1985.
32 citations dealing with 3 questions:
Is there a need for teacher training in the educational uses of the computer (9)
What ideas and competencies should be considered when planning and implementing teacher training programs (14)
What has been done to deal with this problem (9)

ED 260 702 Proceedings of the Annual Conference on "Role of the computer in education" (5th, Arlington Heights, Ill, Feb 20-22, 1985)
Glenview, Ill: Micro-Ideas, 1985.
46 papers summarizing the work of groups trying to integrate the use of the computer into established curriculum: 4 pre-college computer curricula, computer sci. for secondary schools: course content, assessing library micro-computer needs, word processors, structured BASIC on micro-computers in Biological Ed.

ED 261 405 Hubert, Henry. "Computers and composition: annotated bibliography, 1985."
Discusses the direction computing in composition is taking. (Elementary-College levels) Evaluates courseware, computers and classroom management, computers and research databases, computers and reading, word processing, etc.

ED 263 884 Van Dusseldorp, Ralph. "Education=Micro-computers, classrooms, and children." Proceedings of the annual statewide conference of the Alaska Association for computers in Education (4th, Anchorage, Ala, April 4-6, 1985)
Alaska Assoc. for Computers in Education.
31 papers oriented toward the use of computers in the Elementary and secondary schools. Deals with administrative and instructional micro-computer applications:
Micro-computer literacy models (Ala); distance education; trends and issues in LOGO; CAI development (Ala); PLATO & EDNET; software copyrights; developing software to meet the needs of the Native Alaskans; integrating computer software into the school curriculums.

ED 263 912 Deasey, Richard J. "Computers in instruction" Rep. of the Task Force on the use of computers in instruction, 1984. Maryland State Dept. of Ed., Baltimore.
The Maryland Task Force conducted a statewide survey of the following components of successful computer education

programs: planning, curriculum development, staff development, computer use, instructional equity, maintenance, evaluation of hardware and courseware, parent and community involvement. Task Force developed 34 recommendations for improvement.

ED 264 045 School district planning for grades 3-8. Computers in the classroom. Instructional Micro-computer project for Arkansas classrooms. Arkansas State Dept. of Ed., Little Rock, 1984.

Guidelines for the preparation of school district plans for the implementation of micro-computer instructional programs recommended for Arkansas schools. Suggestions for school administrative leadership activities in micro-computer utilization and planning. Topics: CAI, micro-computer basic skills labs, basic skills testing and prescriptive programs, basic skills mastery management systems, research related to the instructional micro-computer project for Arkansas classrooms (IMPAC) and on-site visitation programs. Second section has guidelines for development of IMPAC approved program and list of courseware. 3rd section has specific information on selected IMPAC activities and more generic information on micro-computer cost, effectiveness based on educational research, scheduling computer time, mocro-computer instruction in the classroom vs laboratory, selecting peripherals, etc.

ED 265 822 Hood, John F. and others. "Micro-computers in schools, 1984-1985. Comprehensive survey and analysis." Mkt. Data Retrieval, Westport Ct.

Report of comprehensive survey of micro-computers and their uses in grades K-12 for public, private, and Catholic Schools in the U.S. Divisions by school type, micro-computer intensity by grade level and type of school, brand, distribution and growth trends. US schools now using 630,000 micros in its schools which is a 75% increse over 1983-4 school year. Public- 85.1%; Catholic- 63.4%; private-46.4%; Senior High- 94.6%; Junior High 82.2%; Elementary- 82.2%. 94.2% of public school districts now use computers for instruction which is an 86.1% increase over last year. Most used: Apple, Radio Shack, and then Commodore.

ED 265 829 "Use of the computer in Louisanna schools." 4th Annual report of La State Dept. of Ed., Baton Rouge, 1985. Micros and use in K-12 schools for the 1984-5 year.

Lists institutions not using computers in instruction, % of schools not using them in 1981-84 and the no. of computers in the schools 1981-84., computer utilization by grade level, makes and models in use, use across subject area, demographics of students using computers in courses, locations of computers in schools, sources computer maintenance, average and total no. of teachers receiving computer training, and sources of funds for computers.

ED 270 073 School Distric planning grades 9-12. Computers in education IMPAC: Instructional Micro-computer project for Arkansas classrooms.
Arkansas State Dept. of Ed., Littlerock, 1985.
Guidelines for the preparation of school district plans for the implementation of micro-computer instructional programs for Arkansas High Schools. History and description of the IMPAC project, results of a statewide micro-computer survey, statement of IMPAC's philosophy and goals, recommendations to the school administrators for provision of leadership to school microcomputer activities, descriptions of 6 areas in which high schools have used mocro-computers for instructional purposes, recommendations for selection of hardware and software, space and furniture, teacher inservice training, school district planning guide, distribution of software evaluation sources, equipment bid specifications and maintenance agreements, etc.

ED 271 099 Roblyer, M.D. "Abstract proceedings of the Florida Instructional computing conference" (Orlando, Fla, Jan 21-24, 1986) Florida State Dept. of Ed. Tallahasse, Office of Educational Technology.
Current issues in the educational uses for microcomputers. 139 abstracts each having the name and address of a person to contact if more information is needed. Topics: factors of computer use in the classroom; computer lab utilization; teaching geometry, science, math, English via micros; applications of micros in vocational or special ed; teaching online bibliographic searching; interacitve video; authoring systems; management of computer resources K-12; problems caused by increased use of technology in educational settings; computer literacy for faculty and staff; software evaluation and instructional design.

ED 272 162 "Bringing ideas to reality: technology in our schools." proceedings of a Regional Invitational Forum (2nd, Orlando, Fla., 1985) South Eastern Regional Council for Educational Improvement, Research Triangle park, N.C.
Deals with:
1. Issues related to the purposes, roles, and practices of the schools in regard to the new technologies.
2. Strategies for integrating computers, CAI, etc. into the curriculum and into school management.
3. Different paths educators may follow:
a) Full exploration of creative and effective uses of electronic technologies.
b) Use of computers in instruction without making changes in the curriculum to accomodate computers.
c) Anticipation of far-reaching changes in the curriculum and public education caused by technology and rethinking the purpose of education accordingly.

ED 260 688 Harvey, Wayne. "Designing educational software for tomorrow."
Menlo park, Ca: SRI International, 1985.
Management and use of computer software in education and training needed. Explores good and poor software design and calls for improvements in quality of educational software by attending to design considerations based on general principles of learning rather than specific educational objectives. Topics:
Goals for computer used in educ.; software design process and source of quality productions; student orientation to software; ways to facilitate student understanding; promising directions to pursue; advanced instrutional technology program at SRI International.

ED 262 775 Naron, Nancy K. "Technology in the schools: trends and policies." Annual meeting of American Educational Research Association (Chicago, Ill, March 31-April 4, 1985)
Study of the impact of technology on education is an in-depth case study of 25 educational institutions, both public school districts and colleges and universities.

ED 272 183 Klier, Bertje and others. "Technology and the longer view." Proceedings of the Annual National Conference on Technology and Education (1st, Fort Worth, Texas, April 19-20, 1984)
To address challenges to education posed by new information technologies. participants from 41 states, publishers, educators, administrators, teachers, subject specialists, leaders in the field of educational computing. 10 papers; 4 keynote speeches.

ED 271 125 Weller, Carolyn, ed. "ERIC Clearinghouse Publications, 1985. Annotated bibliography of Information Analysis Products and other major publications of ERIC Jan-Dec, 1985.
Broad range of education-related topics:
Adult, career, and vocational ed; counseling and personal services; reading and communication skills; educational management; handicapped and gifted children; languages and linguistics; higher education; information resources; junior colleges; elementary and early childhood education; rural education and small schools; science, math., and environmental education; social studies/social science education; teacher education; tests, measurements, and evaluations; urban education.

address for EDRS on p. 19

Readings

Ahl, David H. "School uses of micro-computers." Creative Computing 1 (10) October 1983: 185-86.
Report of the results of a national survey of school uses of micro-computers by the Center for Social Organization of Schools.

Creative Computing
Ahl Computing Inc. (subsidiary of Ziff Davis)
P.O. Box 5214
Boulder, CO 80321

Kearsley, G. Hunter, B. and Seidel, R.J. "Two decades of computer-based instruction projects: what have we learned?" Technological Horizons in Education 10 (4) February 1983: 88-96.
Presents an overview of computer-based instructional research and discusses 9 conclusions from these projects.

Technological Horizons in Education
Information Synergy, Inc.
P.O. Box 992
Acton, MA 01720

Conferences/Individual papers

Brumbaugh, K.E. "Panel discussion 3C: a state model for the support of Educational micro-computing." (USA) Computers in Education: World Conference on Computers in Education (3rd, Lausanne, Switzerland, July 27-31, 1981)
Discusses the acquisition of technical support for computer use in education, alternatives for purchase, development of micro-computer software. Minnesota Educational Computing Consortium (MECC) which coordinates and provides computer services to students, teachers, and educational administrators throughout the state, provides the information for the discussion.

North-Holland
sole distributors in the U.S. and Can.
Elsevier North-Holland, Inc.
52 Vanderbilt Ave.
NY, NY 10017

Burney, James D. "Alabama educational computing research and development network." Computers in education: World Conference on Computers in Education (4th, Norfolk, Va., July 29-August 2, 1985)
Formation and implementation of the Alabama Educational Cooperating Research and Development Network; its philosophy, project history and organization, development of CAI software, and programs to date.

see North-Holland above

Cerych, Ladislav. "Computer education in six countries: policy problems and issues." Report for the Ministry of Education and Science, Directorate-General for Science policy, The Hague, 1982.
The concept of a national policy for computer education, issues of computer education, conclusions, and lessons from national experiences. (Federal Republic of Germany, Denmark, France, England, Scotland, Wales, and the U.S.A.)

Science Policy Information Dept.
Ministry of Education and Science
P.O. Box 20601
2500 EP The Hague
Netherlands

Hamblen, John W. "Status of computer science education in U.S.A. higher education: 1982-83." Computers in education: world conference on computers in education (4th, Norfolk, Va, July 29-Aug 2, 1985)
Huge growth in enrollment for four year computer related degree programs in the U.S., but the number of graduates from these programs in 1983 was only half of what was needed, the number of masters degrees about one sixth of those needed; the number of doctorates abo t one fifth of what was needed.

North-Holland at beginning of section

Hofstetter, Fred T. "A model for administering computer-based education." (USA) Computers in education: world conference on Computers in Education (3rd, Lausanne, Switzerland, July 27-31, 1981)
Delaware PLATO project: a model for administering computer-based education. Faculty leadership, system selection criteria, centralized control of resources, development of new materials, clear statement of mission, financial rationale, staff development, publicity of research, etc.

Conferences in entirety

Extending the human mind: computers in education. proceedings of Summer Computer Conference of the Center for Advanced Technology in Education (4th, Eugene, Oregon, August 19-21, 1985)
47 papers dealing with: computers in elementary education, language arts, mathematics, science, social studies, arts, business, music, health, special education, programming, instructional design, problem solving, computer networking, classroom management, computer coordination, hardware/software purchasing, legal implications, etc.

Center for Advanced Technology in Education
College of Education
University of Oregon
Eugene, Oregon 97403

Micro-computers in education conference: who's in charge? (7th, Arizona State Univ., March 11-13, 1987)
Assemblage of educators who are leading the way in micro-computer education. Wide range of papers on CAI, projects, hardware, software, training, etc.

Computer Science Press, Inc.
1803 Research Boulevard
Rockville, Maryland 20850

Ask for list of other conferences concerning micro-computers in education they have published.

England

ED 271 121 Sources of educational information: European survey, 1984.
Strasbourg, France, Council of Europe, Documentation Center for Education in Europe (Austria, Belgium, Cyprus, Denmark, Finland, Iceland, Ireland, Lichtenstein, Luxembourg, Switzerland, and the UK)
For each country, details are given for sources of educational information in connection with agencies dealing with educational policy, reform/development, sources of information in connection with associations (teacher, parent, pupil), agencies collecting and disseminating information, published guides to sources of information, and computer-based educational information.

ED 272 169 Hartley, Roger. "Developments in computer-based learning: a view from the UK Annual Meeting of the American Educational Research Association (67th, San Francisco, Ca, April 16-20, 1986)
Overview of current status of computer-based learning in the UK. Microelectronics Educational Program, MEP, started in 1981 to: provide in-service teacher training in the educational aspects of microelectronics, stimulate and service curriculum development efforts by using computer technology, and disseminate programmed materials and information (Microelectronics support Unit replaced MEP in 1986) MEP experience is described: successes, failures, research and development activities. 8 references.

D. The school environment in Australia/japan (more newly industrialized)

1. Computer/CAI background information for Australia

Australia doesn't have a national education system. All of the schools are the responsibility of each of the states although the Commonwealth will make annual grants for many programs. (there are six states; two territories)

Computers have been used for teaching and administration purposes in the schools for more than ten years and longer than that in the universities. One early report on the state of computer use in education was, "Computers and teaching in Australia " by Wearing et al, 1976. The report was to promote discussion among computer users. The impact of micro-computers was starting to be felt in 1979 and caused the publication of the Computer Society's monograph, "The Micro-computer revolution" by Caelli, 1979 in which implications for education were noted. The Keeves report by Keeves, 1982 advocated courses to provide an introduction to the new technologies of which computing and computer science were a part. Also in 1982 a national research study was commissioned to study where computers are relevant to educational systems. In 1983 3 major reports were published on computers in schools. The Schools Commission report developed recommendations for a National Computer Education programme for the years 1984-1986. By the end of 1983, the majority of the secondary schools had a t least one micro-computer and the number of computers in Elementary schools increased too. Not all of the states supported computing from the beginning. In 1983, those states not already set up with computer units did so and discovered that a co-ordinated, centralized authority was needed to advise the schools in computing programs as there was such a variety of micro-computers being used and little software sharing was possible because of incompatibility. The states involved longest have a centralized approach: Tasmania, South Australia, and Western Australia formed a consortium in 1982 called TASAWA. The benefits of it are the sharing of information and software availability to schools in each state on same cost basis. Most of the state education departments approved Apple II/IIe's (7 of 8) followed by BBC (6 of 8) then Commodore 64's (3 of 8) Where programming is taught, most used BASIC. The 3 states of TASAWA develop the majority of software.

The developments at the national level include:

Subject and professional associations such as the Australian Computing Society

Consortium meetings of the Australian Educational Council and Directors General of Education as well as school computing personnel.

The Commonwealth Schools Commission has concluded that a large expenditure is necessary to overcome the current deficiencies in the provisions at hand for computer education. Support was promised by the major political parties but the final funding fell well short of the original sum sought.

The curriculum development planning emphasizes the need to make general purpose software, word processing, spreadsheet, and database tools available to teachers. A national co-ordinating committee should develop procedures for evaluating the program and for research and development activities.

Teaching institutions:

Several universities offer first degrees or post-graduate diplomas in Computing Science though very few of these graduates enter teaching. (industry)

For the classroom teacher, computing centers offer many short, non-credit courses. Computer user groups, professional associations, and computer companies also provide opportunities for first hand learning. The Angle park Computing Centre (So. Aust.) has developed a package of computer awareness teacher support materials known through Australia. It is for any secondary level of pre-service education such as computer familiarization and instructional uses of computers and is available through some universities and colleges of advanced education.

2. Computer/CAI background information for Japan

The application of CAI in education at primary and lower secondary levels are rare in Japan. Recently in elementary schools, it is mainly used for drills in arithmetic or science; in the lower secondary schools mainly as a tutorial in math. or science; in upper secondary schools for understanding scientific concepts or doing calculation (tutorials using card format)

A number of system/courseware evaluations have been conducted but no assessments have been made by any specific organizations. Some findings:

The use of Kanji combined with Kana creates a number of hardware and software problems because for CAI in Japan there is no similar device to a typewriter for daily activities.

pattern matching is very common in processing and analysing response statements and the problem with the characters as stated above makes it hard to develop any kind of CAI language recognition system.

It is difficult to develop techniques for preparing courseware because the relationships between the instructional materials and learner abilities are not introduced in a clearly understood context.

Cognitive CAI is gradually being developed but at the university level and opinions vary greatly.

As far as equipment is concerned, there are very few practical systems in existence; fewer than 0.1 % of the schools have anything at all. It is felt that this will change rapidly in the near future as a result of the increased availability of micro-computers and stand-alone CAI. The available equipment has been financed by the Ministry of Education and local governments.

The primary reason for introducing CAI is to offer the students a means for coping with individual differences. In Japan with its single language, unified educational system and curriculum, the emphasis is more likely to be upon ensuring the scholastic abilities of slow learners and levelling out differnees in educational progress. A second aim is to help teachers improve lesson plan development skills.

Systems development is conducted primarily by companies and universities. Administration and management is handled by local educational organizations (elementary or lower secondary) Technical support is frequently given at the university level; courseware development is handled mainly by local school and university teachers. A standardized CAI language was developed during the very early days of the computer movement and has been a major influence in the development of CAI . It enables the major commands to be displayed at the terminal and program logic

could be developed frame by frame. The language is not powerful in comparison to ELIZA or TUTOR. Because of the micro-computer, BASIC is now seen as a data-base system and APL and other languages are beginning to be used. There is no system for nationwide documentation of the CAI materials to make the ease of management and exchangeability available.

CAI research and development began in the mid-1960's and remained experimental until the mid-1970's. The programmes developed did not become a part of the regular curriculum because of the cost and systems were only available in 4 or 5 research centres. There was nothing in any public educational facilities during this period. In the mid-1970's, several systems were introduced into a few lower elementary schools and some CAI programs were incorporated into the regular curriculum but not systematically. Even today, CAI is incorporated only as a part of a course of study within the academic year's overall schedule. There are problems in developing the needed new organizations and curricula to manage and administer CAI and teacher training curriculum must be reorganized. Resolving the problem of processing Kanji is still a major item in the improvement of conditions to allow CAI to be diffused into Japan's educational system. Improvements in techniques for computer-recognition of handwritten patterns are needed since there is nothing equal to a typewriter available. The voice recognition techniques are being developed as well.

E. Sources for information on the school environments in Australia/Japan with additional sources for Canada

Australia

Books

Anderson, Jonathan. Computing in schools: an Australian perspective.
Hawthorne, Victoria: Australian Council for Educational Research, 1984 (Australian Educ. Review no. 21)

Brief introduction to micro-computers and micro-computer characteristics important for school use followed by review of educational applications. An examination of models in computer education outside Australia: UK, France, US, England, Scotland. Recent developments at state and national levels in Australia described; varied applications of educational computing in Australia; computer studies at upper secondary level; statewide computer network; emerging issues in computer education for Australia. Seven page reference list.

Australian Council for Educational Research Ltd.
Atten: Mr. Peter Jeffery
P.O. Box 210
Hawthorne, Victoria 3122

also available from EDRS p. 23
ED 246 860

ERIC Documents

ED 240 987 Shears, L.W. and Dale, E.C. "Computers in Education: a report to the honorable Robert Fordham, M.P., Minister of Education, Victoria
Victoria: Victoria Education Department, 1983

Surveys the current commitment to computers in education in many countries with emphasis on Australia. Includes: Japan, Germany, and Sweden (developed but reluctant); Norway, France, UK, USA, and Canada (developed & committed); China, Thailand (developing). Summary of the status of computers in the schools for each state and territory; 20 recommendations regarding computer use in Australian schools; bibliography of 126 items.

ED 247 933 Cheney, B.J. ed. "Information management" VALA Conference on library automation proceedings (2nd, Melbourne, Australia, Nov 28-Dec 1, 1983) vol. 1
Melbourne Australia: Victorian Association for Library Automation, 1984.

This is the first of two volumes of the entire conference proceedings dealing with:

school libraries and computers, public information systems in Australia, public access catalogs, Australian telecommunication services, constructing national databases, models for library co-operation using online computer systems, and information management. The two volumes can also be purchase for $25.00:

Victorian Assoc. for Library Automation
GPO Box 2342V
Melbourne, Victoria, Australia 3001

ED 248 852 Curriculum support applications in secondary schools.
Angle park, Australia, Angle park Computing Centre, 1982

Database management system, Query-by-Example, installed on IBM 4331 system and tested in 10 schools in the Angle park School district over a 1 year period to see how it would process information essential for running the individual schools and provide support for curriculum activities. (local software) Descriptions of the experience.

ED 272 156 Birch, Ian. "Interface between education and technology, Australia. Ed & Polity 1
Bangkok, Thailand; UNESCO, 1984

Current developments in education and technology in Australia and various issues raised. Implications for policy development and implementation. Bibliography.

ED 271 360 Hughes, Phillip. "Interface between education and state policy: Australia. Ed & Polity 2
Bangkok, Thailand: UNESCO, 1985

Interface of education with communications, employment and leisure, state policy, and technology. Ch. 1 shows interdependencies between education and political, economic, social, and technological sectors. Ch. 2 gives 3 case studies: secondary ed; language, education, & polity; planned allocation of resources. Also four scenarios for future resource planning.

Hall, Neil. "Computers in education: a course for teachers." Computers in Education: World Conference on Computers in Education (4th, Norfolk, Va, July 29-August 2, 1985) (Australia)
Riverina College of Advanced Education offers course on computers in education for school teachers; available only through correspondence study. Emphasis on applying micro-computers across the curriculum.

Hammond, Judith. "Creating a national computer education program, the Australian beginning." (Australia) Computers in Education: World Conference on Computers in Education (4th, Norfolk, Va, July 29-August 2, 1985)
Computer incorporation across all territories and states in Australia has not been even. There is a lack of co-ordination in the introduction of computers into the schools in the 1980's. program, recommendations and first activities involved in national program.

Hammond, Judith. "Computer education for the community: an Australian experiment." (Australia) Computers in Education: World Conference on Computers in Education (3rd, Lausanne, Switzerland, July 27-31, 1981)
Computer education for the general public has not matched the growth in the computer industry. The current situation in New South Wales is described and possible directions for education in the area of computer technology outlined.

Hammond, Morrison F. "Cognitive and visual elements of using a computer for instruction." (Australia) Computers in Education: World Conference on Computers in Education (4th, Norfolk, Va, July 29-August 2, 1985)
Research on the place of the learner as a receiver of computerized teaching. Consideration of the perceptual and cognitive aspects of the process of computerized learning.

Penter, Kevan. "Computers in Elementary and Secondary schools in Western Australia." Computers in education: World Conference on Computers in Education (3rd, Lausanne, Switzerland, July 27-31, 1981)
Describes the aims andpolicies of the Education Department of Western Australia in respect to computing and information processing education.

Hoffman, Nathan and Skidmore, Peter. "Developing courseware for schools in Western Australia." Computers in Education: World Conference on Computers in Education (4th, Norfolk, Va, July 29-August 2, 1985)
Methodology used by Education Dept. of W. Australia to develop courseware by combining the skills of the teachers with the skills of programmers. WESOFT software.

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Japan

ERIC Documents

ED 260 704 — Ikai, Akira. "Use of computers in education in Japan." Tokyo, National Institution for Educational Research, 1984.

Summary of computer uses among education centers, research institutes and schools in Japan. Topics: use of computers in local education centers and research institutes; number schools and teachers taking advanced data processing services at Aichi prefectural education center; contents of in-service training for teachers and other education-related personnel at Aichi prefecture; distribution of micro-computers among schools with grade level and public/private school designations; uses of micro-computers in schools in Japan; situations regarding micro-computers and requests for their introduction among schools in the Aichi prefecture, etc.

ED 266 775 — Computers in Education: an outline of country experiences. Report of the Asian Seminar on Educational Technology (3rd, Tokyo, Japan, Sept 26-Oct 2, 1984) UNESCO

Applications and history of computers in the educational systems of:

China, Japan, Thailand, Sri Lanka, India, Australia, Rep. of Korea, Malaysia, Phillippines, and Singapore. Topics: background information on the development of computers including policies, programs, research, and training; trends and issues in computer education; current activities in the area of educational technology.

ED 269 340 — Education in Asia and the pacific: Reviews, reports, and notes no 22.

Special reports:

Educational reform in Japan and western Australia

Eight recent puplications and studies on:

Core curriculums in Asia and the pacific region; schooling as preparation for work in Australia and Korea; educational participation in rural Nepal; standards in community schools; management of local support to education in Thailand, etc.

Brief reports on programs and projects.

ED 272 149 — Final report of the Asian Seminar on Educational Technology (3rd, Tokyo, Japan, Sept 26-Oct 2, 1984)

Teacher training and retraining, curriculum materials for teacher training, quality and availability of software, determining priorities in purchasing micro-computers, equality of access, developing policy, guidelines for curriculum evaluation and development in computer education, 13 recommendations for curriculum organization, teacher training, regional cooperation, and UNESCO/APEID responsibilities. Also curriculum guide from Japanese Ministry of Education, Science, and Culture for micro-computer training of educators.

EDRS address p. 19

Conferences

Ishikawa, Ken and Baba, Nobuo. "Computer science education based on micro-operations." (Japan) Computers in education: World Conference on Computers in Education (4th, Norfolk, Va, July 29-Aug 2, 1985)

Micro-operational computer system EDCOM has been developed and used to teach data flow and computer programming. It provides a concrete data flow model that substitutes memory boxes, calculation boxes, buses and gates for five computer units. To study the control mechanism with actual feeling, the gates can be operated by the learner. Regardless of age of student, learning was achieved 33% faster with EDCOM applied tomachine programming courses.

Otsuki, Setsuko and Takeuchi, Akira. "Intelligent CAL system based on teaching strategy and learner model." (Japan) Computers in education: World Conference on computers in education (4th, Norfolk, Va, July 29-August 2, 1985)

proposal of a computer assisted learning system called BOOK which allows learners to study independently through natural language dialogues and offers teachers facilities for authoring coursewares and knowledge.

Takahashi, Kunio; Suetake, Kunihiro; Hirose, Sadaki. "Computer Science education for all students." (Japan) Computers in Education: World Conference on Computers in Education (4th, Norfolk, Va, July 29-August 2, 1985)

Kanagawa University has provided introductory computer science education for all students. (1200 this year) Curriculum is taught at an audio-visual demonstration room with video system and educational TSS room with 51 terminals.

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Canada

ED 240 975 Tennant, W. "Educational software: A Canadian plan for information sharing." JEM Research, Victoria (British Columbia)

project involving intensive search for literature and contacts with individuals in the field concerning educational software. Includes analysis of education software information available to educators, needs assessment of Canadian educators, implementation plan to make these coincide.

ED 263 902 Computing knows no borders. proceedings of the joint conference of Associations for Educational Data Systems and the Educational Computing Organization of Ontario (Toronto, Ontario, Canada, April 21-26, 1985)

88 papers on: Administration use (12), computer studies (13), educational tools (10), LOGO (7), software (9),

special ed (8) Teaching (16), others cutting across several categories (13)

ED 260 687 Stennett, R.G. "Computer assisted instruction: a review of reviews."
Ontario: London Board of Ed., Educational Research Services, 1985.
Review of literature on CAI focuses on the use of CAI with grades K-12 and assesses value of traditional instruction and CAI in promoting student achievement. Also assessed are applications for special ed. 5 pge. bibliog.

ED 265 034 Petruk, Milton W. "Micros in Alberta schools, 1985, final report of resource survey." Alberta Dept. of Education, Edmonton.
To determine the number and current use of micro-computers in Alberta's elementary, junior, and senior high schools. Of 1509 schools, 1271 answered survey and said they had a total of 13,748 computers; this 1271 thought they would purchase 6,859 more computers next year. Dedermined that computer literacy is strong at elementary and junior high levels while courses in computer processing are more popular at Senior High levels. Recommended that in-service teacher education include computer literacy courses because more teachers are needed who are computer literate.

ED 268 764 Sandals, Lauran. "Overview and plan for Canadian implementation of CAI courseware for special needs children, adolescents, and adults." Dept. of Communications, Ottawa (Ontario)
Reviews international research on CAI for special populations and examines the issue in terms of the Canadian policy perspective. Data collection techniques include interviews and field observations with researchers, manufactureers, and policy makers. A generic model is proposed for Special Ed. computer applications. A review of research is followed by a summary and evaluation of public and private courseware. proposes a national policy in terms of federal/provincial governing boards, national dissemination and information networks, national and regional ongoing committees and task forces. Gave information on resources, software, software and hardware companies, evaluation and information sources, and correspondence.

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F. School environments in India (developing)

1. Computer/CAI background for India

In India, it is considered important to keep pace with far-reaching changes in technology and use them in education.

Data processing for business has been accepted by companies and labor organizations and they have more than 1000 systems installed already with 1500 more each year. Availability of hardware is not a problem but trained manpower is. The various agencies of education are always trying to provide funds for setting up computer facilities in educational institutions. The establishment of public data networks to allow easy information exchange and provide remote access to specialized hardware and software is of top priority. Engineering design and social science research has been computerized.

Computers have been in use for data processing and research applications for more than 25 years. The manufacturing of computer hardware started with the establishment of the state-owned Electronics Corp. of India (ECIL) twenty years ago. Two firms are now producing TDC 332 and ICL 2904 series computers (medium range) and are now marketing 32-bit systems. The government is importing the technology for manufacturing midi/maxi range of computers. In the area of microprocessors/minicomputers, 150 firms have industrial approval and 50 of these have started production still in the area of commerical data prpocessing. There is not much orientation toward specialized application areas as CAI yet. There is production of computer peripherals and units are slowly being developed that can all use the same peripherals. Software is exported (custom applications)

There is a severe need for trained personnel in the computer area. Many programs to gain needed manpower on short-term basis have been started, but teachers are in short supply. Four year programs in Computer Science and Engineering are available in 32 Engineering colleges; 12 institutions have Masters programs. There are 1-1½ year diploma programs in computer applications after the BS in 15 universities. Industrial Training institutions have programs for console operators (1 yr), data preparation assistant (6 mos.) The Computer Society of India has organized training programs to train new people, update members, and conduct tests to certify competence.

There is little use of computers to enrich teaching and they are largely used as tools or to teach some form of computer science. There are some instances of the use of CAI and some research is being done. The Dept. of Electronics and the Ministry of Educ. started a national pilot project in 1984 called CLASS which introduces computers at the secondary and higher secondary schools as teaching and learning tools to build awareness and support the curriculum. Micro-computers are used because of the low cost and availabity of software packages in word processing, data based systems, and computer based training packages suitable for school curriculum. 250 of the 55,000 secondary and higher secondary schools in India have been selected for this project and 42 resource centers throughout India are involved in giving assistance to the teachers of these schools, monitoring the implementation of the program (identify problems and solutions), train teachers, maintain computers, interact with each other and with other training institutions, and develop curriculum/teaching strategies. The schools don't all follow the same curriculum or medium of instruction but

all teachers receive a common course. The student curriculum consists mainly of problem solving activities through the use of generic software packages. India needs to produce its own school computers, manufacture microchips on a large scale, develop and manufacture rugged peripherals, accelerate the training of teachers with a new methodology in order to give all students an opportunity, standardize computer hardware, peripherals, etc., teaching materials in differnt languages with proper interfaces to adapt the software to the language needed should be developed (there are 16 different languages in India), evaluation techniques to establish guidelines for program efficiency are needed because of the scarcity of resources. One idea is to have mobile vans with computers, teachers, and VCR's to go around to several schools. At this time, selected teachers are choosing CBL packages from outside India and suggesting specifications to tailor them to the Indian context.

2. Future plans for micro-computer use

a) the creation of prototype development tools, particularly for graphics.

b) tools to incorporate help features to make packages self-instructional.

c) CBL package development in high-level languages to be automatically converted intothe particular machine on which it is to run.

d) the integration of audio-visual aids such as audio tapes/video tapes and slides with CBL packages.

e) the development facilities for the capture of software directly from broadcast.

f) the use of school computers in laboratory and robotics to show control application of computers.

G. Sources for information on the school environment in India with additional developing country materials added

ERIC Documents

ED 262 780 Neelameghan, A. "Improving the use of information systems, services, and sources through user education and orientation: some issues with reference to developing countries." Session of the ad hoc committee on education and training policy andprogramme (5th, Paris, Fr, Oct 4-6, 1982)

The under-utilization of information services and systems in developing countries was confirmed by UNESCO surveys and studies. Approaches to help improve the use of information systems if undertaken by international organizations at the national and institutional levels were examined. These approaches:

National information policies and programs should define programs and minimum standards on user education.

National educational policies and programs should set out policies, programs, and minimum standards on schools, universities, and information facilities.

Computerized information systems discussed.

ED 266 775 Computers in education: an outline of country experiences. Report of the Asian Seminar on Educational Technology (3rd, Tokyo, Japan, Sept 26-Oct 2, 1984) UNESCO
Applications of computers in the educational systems of: China, Japan, Thailand, Sri Lanka, India, Australia, Rep. of Korea, Malaysia, Phillippines, Singapore.
EDRS address p. 19

Books/Reports

National workshop on Computer Literacy Curriculum, NCERT, March 26-27, 1984. CLASS: Computer literacy and studies in schools report.
New Delhi, National Council of Educational Research and Training (NCERT), 1984.
Dept. of Electronics and Ministry of Education's launching of a program for computer literacy and studies in schools on a national scale for 1984-85. The program is expected to be extended into other schools after the initial 250 for this time period.

National Council of Educational Research
and Training
Sri Aurobindo Marg
New Delhi 10016

One could inquire of other reports on the progress of computers in education from this source.

Other Developing Country Sources

ERIC Documents

ED 222 199 Griffiths, Jose-Marie. "Application of minicomputers and micro-computers to information handling." UNESCO, 1981
Assessment of application of mini- and micro-computers to information handling procedures and makes recommendations for automating such procedures especially in developing countries.

ED 233 682 Mills, Miriam K. "Computer conferencing for the third world: roadmap for the future." Annual Conference of the International Studies Assoc. (7th, Mexico City, Mexico, April 5-9, 1983)
Consideration of computer conferencing for the Third World. Description of a computer conferencing system, discussions on telecommunications and activities of multinational organizations which affect extension of technology to developing nations, applications of computer conferencing to education, employment, and information transfer, and guidelines for implementation of computer conferencing.

ED 239 649 Asia Section. Regional activities division. IFLA, the Hague, 1983. papers presented at the Annual Conference of the IFLA (49th, Munich, West Germany, August 21-27,

1983.

Two papers on library and information activities in developing nations, particularly in India and other Asian countries. Modern technology and its impact on involvement in developing countries, information technology transfer, involvement of of the Third World in IFLA, etc.

ED 240 988 Development Communication Report no. 44. Academy for Educational Development, Washington DC Clearinghouse on Development communication. Agency for International Development (Dept of State), Washington, DC, 1983.

Projects in several contries: textbooks, educational radio & television, micro-computers in developing countries, etc. Also reviews of development books, and publications from the non-formal Education Information Center at Michigan State University and ERIC. (Ecuador, Niger, Papua New Guinea)

ED 241 018 Lancaster, F. Wilfrid and Smith, Linda C. "Compatibility issues affecting information systems and services." UNESCO, 1983.

Issues related to compatibility and standardization of bibliographic records, index languages, software, hardware, andother information systems and services.

ED 255 185 The computer in education and training. Report of the main committee of the HSRC Education Research programme. Pretoria, So. Africa: Human Sciences Research Council, 1983

Findings and recommendations of investigation surveyed and evaluated the current educational situation in South Africa and recommendations on the use of computers in education and training. Topics: computers in formal and nonformal education, strategies for the introduction of computer awareness and literacy, co-ordination of activities in the use of the computer in education and training, suggested specifications for micro-computer systems, specifications and criteria for design and evaluation of educational courseware, cost analysis for the integration of the computer in education, etc.

ED 272 175 "Micro-computer and bibliographic information systems in Latin America: problems, experiences, andprojections." proceedings of a meeting (Santiago, Chile, April 24-27, 1984)
Ottawa (Ontario): International Development Research Center, 1984

Many institutions are setting up databases using existing computerized information and documentation networks and relying on new micro-computer equipment for implementation. There is an awareness of the need for regional effort with these objectives:

examine experiences with micro-computer-based bibliographic systems.

discuss the basic software specifications for users.

review methods for analyzing commericial and non-commericial micro-computer-based bibliographic retrieval software.

examine the feasibility of creating or modifying software.

analyze problems raised by the exchange of data and software between differentcompanies.

identify schemes for resolving problems.

Conferences

Chandra, peter. "Implementing CAL in developing countries - some considerations"(with examples from Sri Lanka) Computers in education: World Conference on Computers in education (4th, Norfolk, Va, July 29-August 2, 1985)

A look at Sri Lanka with examples of the problems and considerations involved in introducing CAL into schools there. A critical examination of the urgents needs and problems of the country and the government's considerations in deciding whether or not computers will be introduced into the schools.

de Wet, J.J. and Calitz, L.P. "Educational needs and problems in Africa and the use of CAL." Computers in education: World Conference on Computers in Education (3rd, Lausanne, Switzerland, July 27-31, 1981)

The diversity in education in Africa is great, but there are common problems that can be helped through use of CAL: to supplement and improve poor classroom teaching, useful in correspondence education, further education, teacher training, and secondary education. proposes establishment of international and national CAL Centres.

Grunberg, Jorge and Bolana, Alberto. "Alpha project: a pilot project for the integration of information technology in the national secondary school educational system in Uruguay." Computers in education: World Conference on Computers in Education (4th, Norfolk, Va, July 29-August 2, 1985)

Alpha project possible through cooperation between ORT and the Ministry of Uruguay with financial backing from IBM Uruguay. The aim is the planned integration of information technology into the secondary school educational system. Description of the technical feasibility analysis, operating structure, and operational objectives.

Gulati, D.V. "Computer education and the needs of developing countries." Computers in Education: World Conference on Computers in Education (3rd, Lausanne, Switzerland, July 27-31, 1981)

Teaching computing as computer science covers some aspects of data processing, but does not help with the problem of acquiring applications from vocationally oriented professionals. An integrated operational model is suggested for creatingspecial purpose facilities within each country which will

be adaptive enough to take account of each country's needs and adjust to environmental changes.

Kang Hoh phua, paul. "Computer training programme for college teachers." Computers in education: World Conference of Computers in Education (4th, Norfolk, Va, July 29-August 2, 1985)
Description of experiences of the provision of a Diploma course in Computer Science for College teachers in Singapore. Some thoughts of a more general nature applicable to other countries in the region.

Persiasamy, M. and Pitke, M.V. "A multi-language terminal for Computer Education." Computers in Education: World Conference on Computers in Education (4th, Norfolk, Va, July 29-Aug 2, 1985)
Countries having a variety of languages and scripts need special computer terminals to handle these scripts. Design of an input/output terminal for Devanagari script has been presented. A generalized algorithm based on graphical approach has been implemented for use with any computer system having graphic facility. The basic scheme can be adapted for a variety of scripts.

Tung, Douglas S. "Computer education in Hong Kong." Computers in education: World Conference on Computers in Education (4th, Norfolk, Va, July 29-August 2, 1985)
Educational programmes available in Hong Kong. There are four categories of institutions offerring computer education, the computer vendors, the vocational institutes of sponsored or trade associations, agents of overseas companies and profit-making institutes, and the non profit making institutes. Three computer professional organizations have their examination centers in Hong Kong.

Zmud, Robert W. and Cotterman, William W. "A national informatics educational strategy for developing nations." Computers in education: World Conference on Computers in Education (4th, Norfolk, Va, July 29-August 2, 1985)
National informatics educational strategy suggested that seeks to develop, reinforce, and evolve systems infrastructure by exposing citizenry to informatics and making generally applicable information systems available to organizations. The strategy would be effected by media campaigns, informatics application centers, an informatics extension service, and university.

North-Holland address p. 23

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